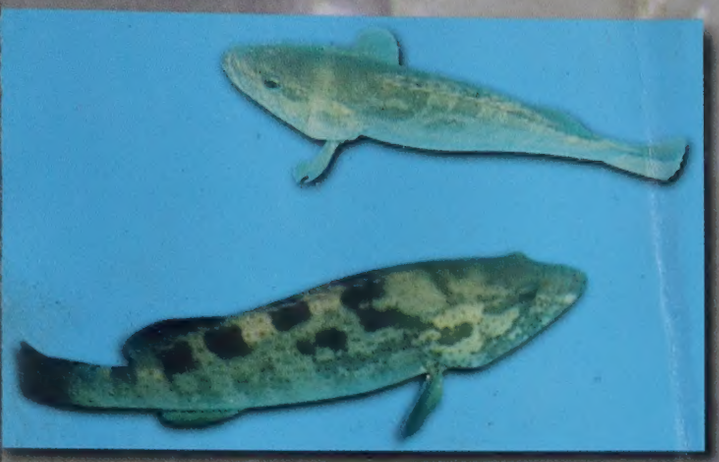

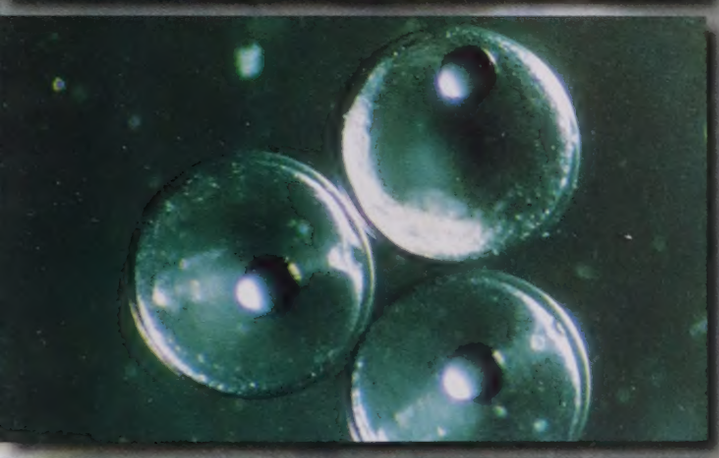

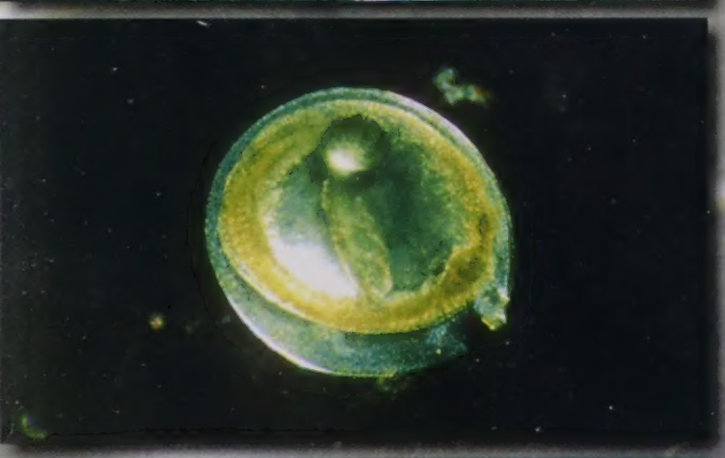

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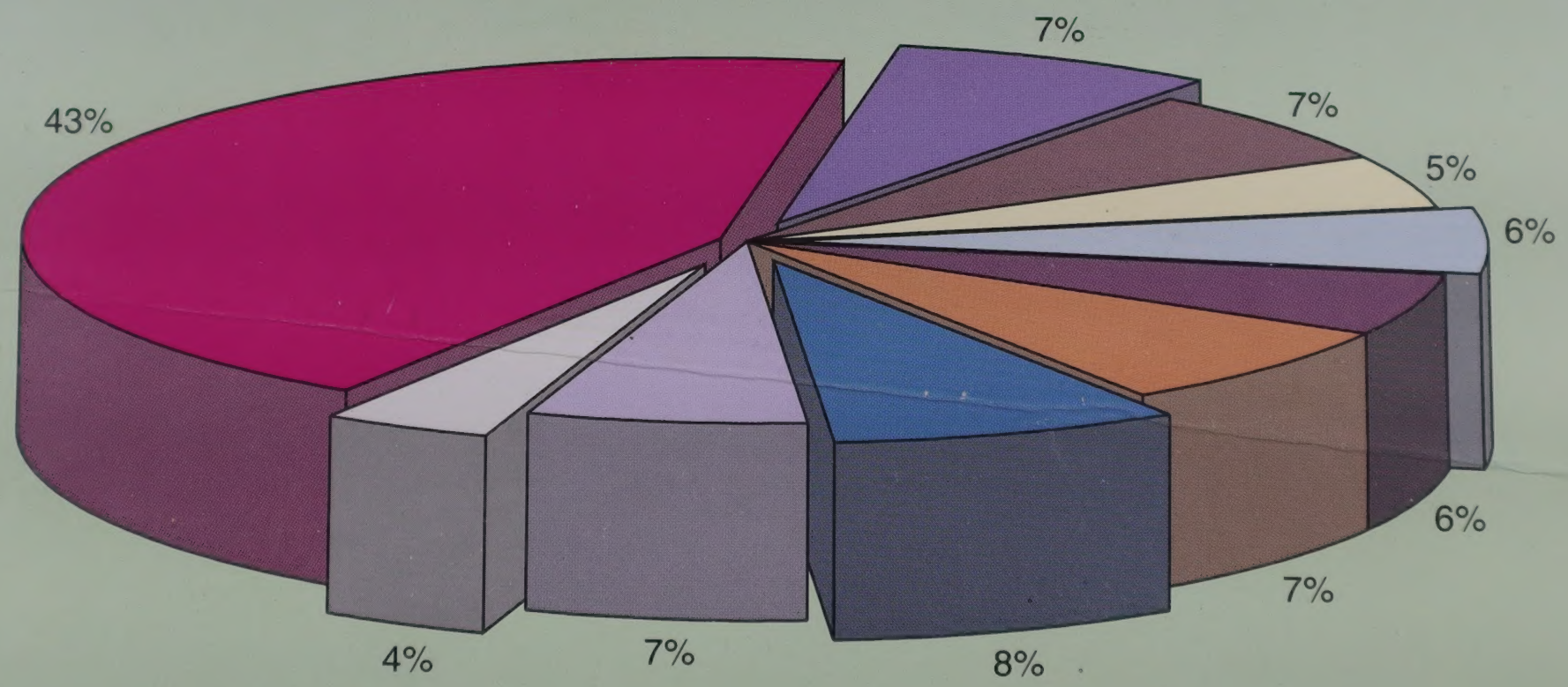
ANNUAL REPORT
1998 - '99

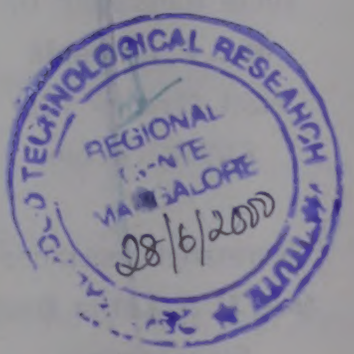
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
Indian Council of Agricultural Research
P.B. No. 1603, Cochin-682 014

Major components of marine fish landing in India-1998

(Total estimated landing : 2.67 mt)



ANNUAL REPORT
1998-1999



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Published by
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Director
CMFRI
Cochin - 682 014

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Printed at
Modern Graphics
Kaloor, Cochin

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Citation : CMFRI 1999. Annual report 1998-99; Central Marine Fisheries Research Institute, Cochin : 171 pp.

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PREFACE

The marine fisheries R&D is receiving increased attention at the National as well as International levels in view of the 1) declining yields of the exploited stocks, necessitating measures to sustain their yields, 2) underexploitation of deep-sea and oceanic resources, warranting the development of strategies for their effective and sustained exploitation, 3) need to combat protein-malnutrition of the rapidly increasing human population, demanding the development and upgradation of mariculture technologies and utilisation of regions and species suitable for culture, and step up the production, and 4) the lack of trained manpower for research and operatives, necessitating increased thrust to Human Resources Development in these areas. The Central Marine Fisheries Research Institute has the mandate to address these issues and has been constantly contributing to the long-term and short-term needs of the industry and the Government through its Research, Education, Extension and Consultancy programmes.

The Institute continued its efforts towards development of sound database on exploited stocks, development and upgradation of mariculture technologies and development of research infrastructure through its own programmes and those sponsored by the funding agencies. Hatchery complexes were built at Mandapam, Cochin, Calicut and Vizhinjam and they are being made operational. Two projects under the NATP were approved by the ICAR for implementation at the Institute. Along with organisations in seven other countries in the Asian region, the Institute took up a collaborative programme with the International Centre for Living Aquatic Resources Management, Philippines on the Sustainable Management of Coastal Fish Stocks in the Asian Region. Besides, collaborative programmes were also undertaken with the NRSA and the SAC in the area of Fishery Forecast.

The Institute achieved breakthrough in broodstock development, maturation, sex reversal, spawning, fertilisation and hatching of the grouper in the onshore, fully-controlled culture system at Cochin, opening up avenues for developing suitable package for culture of groupers. Another breakthrough was achieved in the hatchery development of the cuttlefish and development of F1 generation of the cuttlefish under controlled conditions at Tuticorin. Technology of breeding and seed production of clownfish was also perfected.

A total of nine consultancy projects valued at Rs 27,51,800/- were completed, five projects for Rs 19,19,650/- are under operation and four projects with a total outlay of Rs 6,74,480 are approved for implementation.

The education and training programmes continued as usual; proposals were submitted for establishing a School of Marine Fisheries at the Institute with additional courses leading to M.F.Sc. and Ph.D. degrees in frontier areas of Marine Fisheries Research. Besides, the Institute also made a proposal to start a Division of Marine Biodiversity Conservation to address the issues related to the subject.

The progress of work during 1998-'99 is included in this Report briefly.

The CMFRI, thus, made significant contribution during the year, achieving the targets. All these would not have been possible without the support of the ICAR and the staff of the Institute. I am thankful to Dr. R. S. Paroda, Director General, ICAR for his sustained support and encouragement. Dr. K. Gopakumar, Deputy Director General (Fy) ICAR and Dr. R. A. Selvakumar, Assistant Director General (MFy), ICAR extended all co-operation and support to the Institute in its endeavour. I congratulate all my colleagues in the Institute for their whole-hearted support and contribution in fulfilling the objectives of the Institute.

V. N. PILLAI
Director

Cochin
June, 1999

EXECUTIVE SUMMARY

During the year, the CMFRI implemented 67 ongoing in-house research projects, 12 projects sponsored by funding agencies in India, 2 by SIDA and 1 by ICLARM.

Database on exploited stocks

The total marine fish production in the country was estimated at 2.67 million tonnes which is about 2% less than that obtained during 1997. The mechanized units contributed 73% of the landings followed by motorized units 19% and the artisanal units 8%. The northwestern region comprising Gujarat and Maharashtra contributed 42% of total production in the country followed by southwest 28% (Kerala, Karnataka and Goa), southeast 24% (Andhra Pradesh, Tamilnadu and Pondicherry), northeast 5% (West Bengal, Orissa) and Lakshadweep and Andamans 1%. The landings increased by about 11,000 t over the previous year along northeast coast, declined by about 60,000 t along southeast coast, 71,000 t along southwest coast, and increased by 60,000 t along northwest coast. The penaeid prawn production increased by 3%, nonpenaeid prawn 13%, catfish 18% and threadfin bream 12% over the previous year. The dominant components of marine fish production in 1998 are oilsardine (2.04lakh t), other sardines (1.00 lakh t), mackerel (1.77 lakh t), Bombay duck (1.23 lakh t), penaeid prawn (2.5 lakh t), nonpenaeid prawn (1.74 lakh t), croakers (2 lakh t), threadfin breams (0.8 lakh t) and cephalopods (1.07 lakh t).

All relevant data on a large number of species of pelagic and demersal finfishes crustaceans and molluscs were collected and analyzed to study the fishery and resource characteristics of exploited stocks. In the case of oilsardine the catch declined by 8.5% over the previous year; the ringseine effort increased by 50% resulted in 68% increase in production at Mangalore whereas at Cochin the increase was only 0.9% in the effort but the catch increase was 62%. In anchovies, the IV quarter was most productive at Mangalore; spawning took place during October-May along both the coasts. The seerfish landing was higher (48,000 t) during the year. *Scomberomorus commerson* and *S. guttatus* accounted for 99% of catch. In mackerel, the increase in the mean length noticed in the landings was due to the delay in the commencement of fishery along the southwest coast. Among tunas, *Euthynnus affinis* was most dominant in the coastal waters and *Katsuwonus pelamis* constituted 83% of pole and line catch at Minicoy.

Trichiurus lepturus was the most dominant species forming about 90% of the ribbonfish catch and the maximum quantities were taken by trawl. Trawl and purseseine took maximum catch of carangids.

The total demersal finfish production in the country was 0.7 million t; 68.1% of this was taken by trawl, 13.2% by other

mechanized units, 10.2% by motorized units and 8.5% by artisanal units. Maximum quantity (38.7% of the demersal finfish catch in the country) was obtained from Gujarat followed by Tamilnadu (16.8%), Kerala (13.9%), Maharashtra (11.4%), Karnataka (6%), Andhra Pradesh (5.6%), West Bengal (3.3%), Orissa (2.6%), Goa (1.5%) and Pondicherry (0.2%). The landings of demersal finfish increased by 8% over those of previous year, which is mainly brought about by 47% increase along the northwest coast, though there was considerable decline in the landings along the east coast.

Scoliodon laticaudus was the most common shark in the landings at Mumbai, whereas *Carcharius melanopterus* was dominant at Cochin and *C. bleekeri* at Tuticorin. In the perches, *Epinephelus diacanthus* was the dominant species at Mumbai. In threadfin breams, *Nemipterus japonicus* and *N. mesoprion* were most dominant. In Karnataka peak catch of *N. mesoprion* was obtained in September-November period. Maximum catch was taken along the west coast. Maximum catch of silverbellies was taken along the southeast coast of India; along west coast centres *Leiognathus bindus*, *L. splendens* and *Secutor insidiator* were dominant, along the northeast coast *L. bindus*, *S. insidiator* were abundant whereas along the southeast coast *L. dussumieri* and *L. jonesi* were dominant.

In sciaenids, the species composition and dominant species were different at different centres; maximum catch of this group was taken at Veraval and Mumbai. At Kakinada, an estimated 197 t of juveniles of sciaenids (40-183 mm length) were taken by trawlers with peak in January. In Lizardfish, *Saurida tumbil* was dominant along the west coast except Cochin and *S. undosquamis* along east coast and Cochin. Peak landings were taken during April and December along the northwest coast. The length range of *Polynemus indicus* at Veraval was 170-770 mm in the trawl and 310-1090 mm in gillnet. *P. heptadactylus* was in the length range of 65-275 mm in the trawl at Mumbai

The first and last quarters were productive for pomfrets at Veraval and Mumbai, high catch rates of 250 kg, 725 kg were obtained during August and October at Satpati in gillnet. *Pampus argenteus* was dominant at Mumbai.

Priacanthus hamrur was the principal species of Bull's eye at all the centres and the length range in the catch was 90-330 mm at different centres.

The flatfish fishery was most dominant along the southwest coast. *Cynoglossus macrostomus* was dominant along north Kerala and south Karnataka whereas *C. bilineatus* and *C. macrolepidotus* were dominant along south Kerala and Gulf of Mannar.

Goatfish was abundant along east coast between Mandapam and Visakhapatnam. *U. sundaicus* and *U. sulphureus* were dominant along south Tamilnadu, *U. taeniopterus* along north Tamilnadu, south Andhra and *U. vittatus* along north Andhra coast.

There was improvement in the landings of whitefish along southwest coast.The length range in the catch was 30 -209 mm.

In Kerala non-edible benthic biota formed 7.8% of the total catch, 20.6% in Karnataka and about 3% in Tamilnadu. Along Karnataka 47% of the catch was taken from less than 30 m depth, 34% from the 30-50 m depth and 19% from beyond 50 m depth. In Kerala 40% was taken from less than 30 m whereas in Tamilnadu 80% of the trawl catch was from 0-30 m depth.

Penaeid prawns contributed 42.8% to the crustacean landings followed by non penaeid prawns 36.4%, stomatopods 13.3%, crabs 6.9% and lobsters 0.6%. The west coast contributed 75% of the penaeid catch and northwest coast supported 93% of the nonpenaeid catch. *Parapenaeopsis stylifera* was dominant along the west coast and *Solenocera crassicornis* along northwest coast. *Solenocera choprai* is gaining importance in the landings due to extension of fishing into deeper ground along Kerala and Karnataka coasts. *P. semisulcatus* was dominant along southeast coast and *M. dobsoni* along north Tamilnadu and Andhra coasts.

Gujarat and Maharashtra accounted for 93% of nonpenaeid prawn landings in the country and the fishery improved by 24% during this year. Trawlers contributed to the bulk of nonpenaeid prawn landings. Off Mumbai, exploitation rate of *N. tenuipes* was above optimal level, suggesting the need for reduction in effort. The lobster landings showed decline during the year. Trap and trawl net are the major gears for this resource. *Panulirus polyphagus* and *Thenus orientalis* contributed to the fishery at Veraval and the former species at Mumbai.

Crab landings declined by over 12,000 t. Tamilnadu, Gujarat and Kerala contributed to the bulk of the landings. *Charybdis cruciata* was dominant at Veraval and Mumbai, *P. pelagicus* at Karwar and *P. sanguinolentus* at Mangalore.

In the cephalopod landings a decline was noticed all along the west coast centres but along the east coast centres there was increase in the landings. Squids were the most dominant along west coast and Madras and cuttlefish along other east coast centres. An estimated 3700 t of mussels was landed along the Kerala and Tamilnadu coasts and *Perna indica* was most dominant. In the case of clams, about 38,000 t were landed from Karwar, Mangalore, Cochin, Madras and Kakinada.

Mariculture

A breakthrough was achieved in broodstock development and breeding of grouper (*Epinephelus tauvina*) at Cochin. The achievements in the experiments are successful rearing from fingerlings to broodstock size, sex reversal, maturation, spawning and fertilization. At Vizhinjam clownfish (*Amphiprion chrysogaster*) spawned in confinement in fibreglass tanks and juveniles were reared. Success was achieved for the first time in the induced maturation and spawning of

farm-raised *P. merguiensis* under captive condition at Karwar. *P. monodon* was made to spawn and produce 35,93,000 naupli through artificial insemination. For live feed culture *Brachionus rotundiformis* was reared in sea water of 29-30 ppt salinity and *Moina micrura* was reared at 14-15 ppt salinity in translucent containers. F4 generation of *P. pelagicus* was developed at Mandapam. It was observed that pen culture is suitable for growout of *S. tranquebarica*.

The work on culture, seed production and sea ranching of bivalves progressed well.

A breakthrough in rearing of cuttlefish (*Sepiella inermis*) was achieved at Tuticorin. The larvae reared in the laboratory attained maturity and spawned from the 75th day.

The revolving fund project on pearl culture at Mandapam progressed well; nucleus implantation was done in 43798 oysters. A technique for captive maturation and breeding of pearl oyster standardized at Visakhapatnam.

Monitoring environmental characteristics

Data on various characteristics of the fishery environment were collected using the vessel facilities as well as from the inshore waters. In the pollution-monitoring programme the THA levels were monitored in the water and sediment and it was found to be a stimulant of phytoplankton growth and prevents pollution.

Biodiversity studies were continued in collaboration with Universities and Central Drug Research Institute

Upgradation and transfer of technologies

In the area of improvement of technologies investigations on pathology, nutrition, induced maturation and isolation of substances of pharmacological importance were continued. The extension programme was strengthened taking into account larger areas and more number of women and marginal farmers.

The progress in all the sponsored projects was maintained at desirable levels. A total of 9 consultancy projects were completed and 5 are being continued. Additional 4 projects are approved.

Education and Training

Seven candidates obtained the M.F.Sc. degree and three candidates submitted Ph.D. theses for adjudication. The KVK conducted thirtythree training programmes and the TTC, ten.

INTRODUCTION

India is endowed with a long coastline of 8129 km, 0.5 million sq km of continental shelf, 2.02 million sq km of EEZ and an estimated annual Marine Fishery Resource Potential of 3.9 million tonnes. The vast areas all along the coastline offer ideal sites for seafarming and coastal mariculture. The Indian marine fisheries sector plays a very important role in supplying protein-rich food to the increasing population, employment generation and foreign exchange earning. The present marine fisheries scenario in India is characterised by declining yields from the inshore waters, increasing conflicts between different resource users, increasing demand for fish food for domestic consumption and export and, prospects for large scale seafarming and coastal mariculture. This warrants greater and more effective R&D efforts to enable implement suitable action plans for sustained marine fisheries and mariculture development.

The Central Marine Fisheries Research Institute (established in 1947) is the nodal agency in India, responsible for research support in marine fisheries development. Over the period of nearly half a century since its inception, the CMFRI grew significantly in its size and stature by building up a fairly adequate research infrastructure and recruiting suitably qualified R&D staff. The Institute's multidisciplinary approach to research in marine capture and culture fisheries has won the recognition as a premier Institute comparable to any well-established laboratory in the World.

To accomplish its mandate, the Institute conducts researches on characteristics of exploited marine fish stocks; carries out exploratory surveys and assesses the under- and unexploited resources, develops seafarming techniques, undertakes research in fishery environmental characteristics and sea-dynamics and conducts postgraduate education programmes. Besides, the Institute collects Marine Fisheries Statistics and makes estimation of species-wise landings and monitors the landings on a continual basis from all along the country's coast. Studies are also conducted on economics of fishery enterprises and socio-economic conditions of fisherfolk.

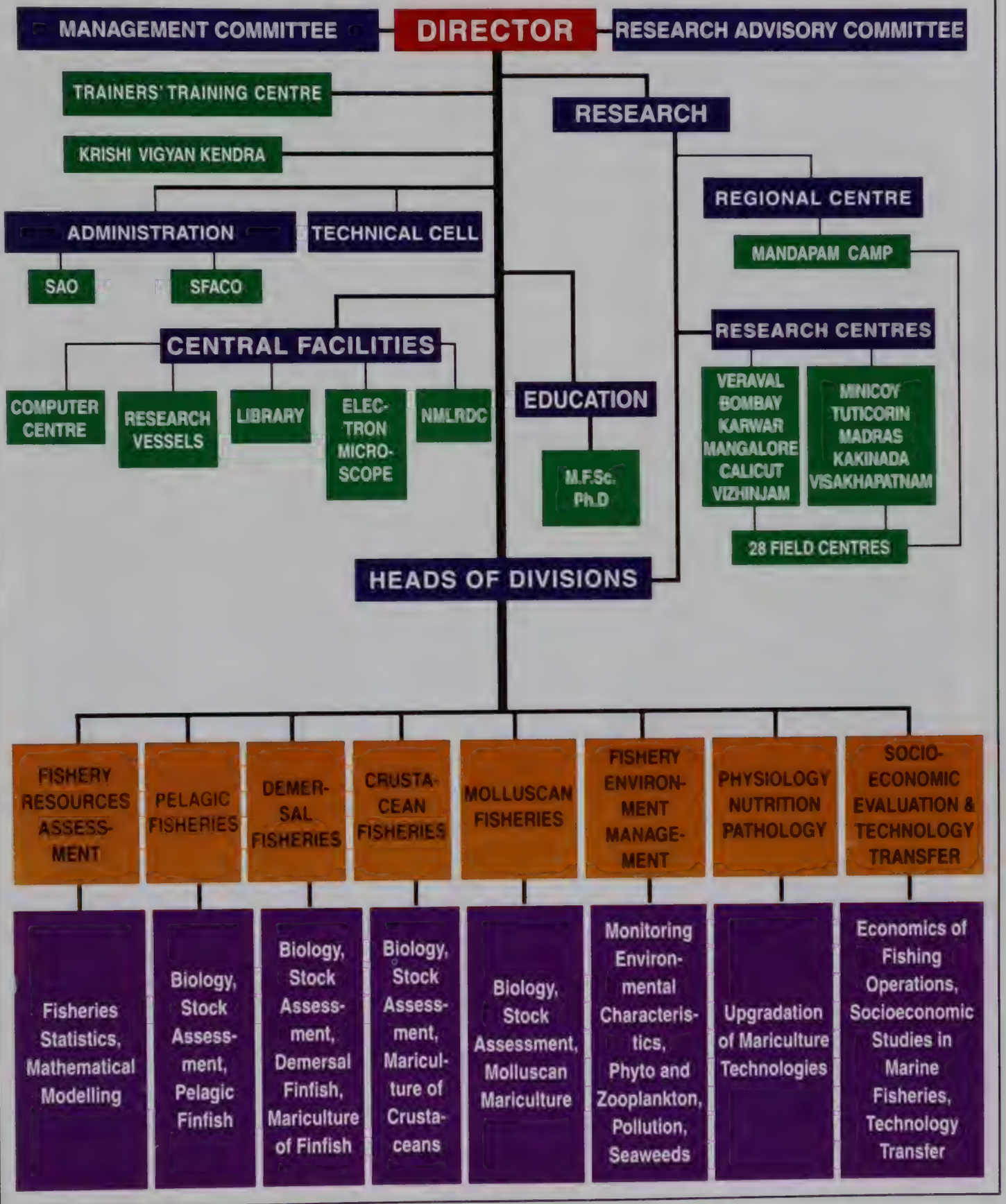
The organisational set-up

To be able to effectively carry out these tasks, the Institute has established a Regional Centre at Mandapam Camp, Research Centres at Minicoy, Veraval, Mumbai, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Madras, Kakinada and Visakhapatnam and 28 Field Centres all

along the coast. The entire activity is coordinated by the Headquarters at Cochin. The Institute has, over the years, built up laboratory and field facilities including Computers and Research Vessels for carrying out research programmes and has been upgrading the same to meet the changing and additional requirements. The sanctioned staff strength of the Institute is: Scientific 189, Technical 445, Ministerial 172, Supporting 296 and Auxillary 39.

The multidisciplinary researches in capture and culture fisheries are conducted under eight Divisions: Fisheries Resources Assessment, Pelagic Fisheries, Demersal Fisheries, Crustacean Fisheries, Molluscan Fisheries, Fishery Environment Management, Physiology, Nutrition and Pathology and Socio-economic Evaluation and Technology Transfer. Interdivisional and Interinstitutional programmes with collaborating agencies are carried out for greater utilisation of expertise and facilities. Besides, the Institute also takes up short-term research projects on important and priority areas sponsored by outside agencies in the country, and offers consultancy services to the clients from Government organisations as well as private industry.

CMFRI COCHIN - ORGANOGRAM



The Mandate

- Assessment and monitoring of the status of the exploited and unexploited fish stocks in the Indian EEZ, the contiguous international waters (for the mesopelagics) and the Southern Ocean (for Antarctic krill and finfish) in relation to fishery independent and fishery dependent factors; evaluation of the technoeconomic and socioeconomics of marine fishing operations.
- Development of suitable technologies for seafarming of finfish, shellfish, seaweeds and other cultivable marine organisms; evaluation of the technoeconomics and socioeconomics of mariculture operations; upgradation of technologies through R&D in frontier areas in Biotechnology, Nutrition, Pathology and Endocrinology.
- Monitoring the health of the coastal ecosystems, particularly the endangered ecosystems in relation to artisanal fishing, mechanised fishing and marine pollution.
- Transfer of viable seafarming technologies through extension education, specialised trainings and consultancy services.
- Postgraduate education in marine fisheries and mariculture leading to M.F.Sc. and Ph.D degrees; introduction of new subjects in frontier areas and establishment of another Deemed University in Fisheries.

Under the Postgraduate Programme in Mariculture, the Institute organises M.F.Sc. and Ph.D. programmes under affiliation to the Central Institute of Fisheries Education – a Deemed University under the ICAR. The teaching programme is carried out by the Scientists of the Institute.

The *Krishi Vigyan Kendra* and the Trainers' Training Centre, impart training in mariculture, agriculture, animal husbandry and other related subjects to fish farmers, agricultural farmers and farm women and the Trainers' Training Centre to officials of State Governments, Banks, Societies and autonomous bodies interested in fisheries development.

The Library and Documentation section provides reference facilities to research staff and students of the Institute as well as to visiting scientists both within and outside the country. The results of researches carried out in the Institute are published in various Journals. Besides, the Institute brings out Bulletins, Special Publications and Marine Fisheries Information Service and publishes the *Indian Journal of Fisheries*.

ESTABLISHMENTS OF
CENTRAL MARINE FISHERIES
RESEARCH INSTITUTE
HEADQUARTERS
REGIONAL CENTRE
RESEARCH CENTRES
FIELD CENTRES
FIELD LAB/FARM
72°
76°
80°
84°
88°
92°
36°
32°
28°
24°
20°
16°
12°
8°
Jamnagar
VERAVAL
Rander
Dahanu
BOMBAY
Janjiramurudu
Ratnagiri
Malvan
Goa
KARWAR
Bhatkal
MANGALORE
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Cuddalore Field Centre of CMFRI
Jawan's Bhavan Lawrence Road
Cuddalore-607 002

Dahanu Field Centre of CMFRI
Kirtane Bungalow,
Maangailwada
Dahanu,
Thana District, Maharashtra

Goa Field Centre of CMFRI
Shri P.R. Phal House
1st Floor, B.B.
Borkar Road
Alto-Porvorim-403 521
Bardez, Goa

Gopalpur Field Centre of CMFRI
Gopalpur-on-sea (P.O.)
Ganjam Dist.,
Orissa

Jamnagar Field Centre of CMFRI
Milan Chambers,
Khoodiyar Colony
Aerodrome Road
Jamnagar-361 006,
Gujarat

Janjira Murud Field Centre of CMFRI
Ground Floor
Janjira Murud-402 401
Raigad District,
Maharashtra

Kannur Field Centre of CMFRI
Office of the Deputy Director of Fisheries
Moppila Bay Fisheries Complex
District Hospital Post
Kannur-670 017

Kanyakumari Field Centre of CMFRI,
Kanyakumari-629 702
Tamil Nadu

Kovalam Field Laboratory of CMFRI
Kovalam - 602 112
Chengulpet Dist
Tamil Nadu

Machilipatnam Field Centre of CMFRI
Machilipatnam-521 002
Andhra Pradesh

Mahabalipuram Field Centre of CMFRI,
Mahabalipuram-603 104
Tamil Nadu

Malwan Field Centre of CMFRI2799/2,
Dawoolwads,
Pawar Chal
Malwan-416 606,
Maharashtra

Narasapur Field Centre of CMFRI
C/o Ratnam Enterprises
Darga Street
Narasapur
West Godavari Distt.
Andhra Pradesh.

Nagappatinam Field Centre of CMFRI
C/o Inspector of Fisheries
Salt Road
14/3, Bazar Peth Road
Nagapattinam-611 001
Thanjavur Dt.,
Tamilnadu

Nellore Field Centre of CMFRI
Room No. 14, Municipal Building
New A.C. Bubba Reddy Statue
Weyyalakalava Street
Nellore-524 001, Andhra Pradesh

Ongole Field Centre of CMFRI
No. 49, A.P. Housing Colony
Manidipakam
Ongole-523 002
Prakasam District
Andhra Pradesh

Palasa Field Centre of CMFRI
K.T. Road (Near Ravi Electricals)
Palasa,
Srikakulam District
Andhra Pradesh

Pattukottai Field Centre of CMFRI
Room No. 23,
Periaswamy Building
187/A, Big Bazar Street
Pattukottai-614 601
Tanjore,
Tamilnadu

Pondicherry Field Centre of CMFRI
Room No. 1,
First Floor
V.K.G. Building
143, Chinnasubraya Street
Pondicherry-605 001

Puri Field Centre of CMFRI
Santikunja Lane
Near Hotel Sea 'n' Sand
Chakratirtha Road
Puri-752 002,
Orissa

Quilon Field Centre of CMFRI
Municipal Stadium Buildings
Ward No. VII, Door No. 737
Quilon, Kerala

Rander Field Centre of CMFRI
II Floor, 'Devikripa'
3/213, Bandariward
Rander, Surat-395 005

Ratnagiri Field Centre of CMFRI
Building No. 3615, Devchand Nivas
Lower Lane, Ratnagiri-415 612
Maharashtra

Srikakulam Field Centre of CMFRI
Door No. 4-1-23/1
Opp. Govt. Employees
Co-operative Stores Ltd., No.A-675,
Srikakulam-532001
Andhra Pradesh

BUDGET 1998-99

(Rs. in lakhs)

Budget Heads	Non Plan		Plan	
	Revised Estimates	Expenditure	Revised Estimates	Expenditure
Establishment charges	1477.00	1268.00 209.00 *	-	-
O.T.A	1.20	1.20	-	-
T.A.	13.00	13.00	15.00	15.00
Other charges	51.00	49.35	220.00	203.17
Works	20.00	21.65	165.00	182.49
Other items	1.80	1.80	25.00	24.34
Total	1564.00	1564.00	425.00	425.00

* Surrendered 209.00

Library and Documentation Section

During the period under report, 158 books and 1564 journals were added to the library at Headquarters. Essential books and journals were also acquired for the libraries at Regional Centre and Research Centres. Inter-library loan of publications and collaboration were continued. Reference and reprographic facilities were provided to visiting Scientists, Scholars and others from within and outside the country. The library also stocks and distributes the Institute publications.

The following publications were issued during the year:

1. *Indian Journal of Fisheries* Vol. 44 No. 4 (1997), Vol. 45 No. 1-3 (1998)
2. *Marine Fisheries Information Service T&E Ser.* Nos. 152-156
3. CMFRI Newsletter No. 80, 81
4. CMFRI Annual Report 1997-98
5. CMFRI Special Publication No. 68
6. Proceedings of the Seminar held in Hindi on "Changing Scenario of Marine Fisheries Research and New Dimensions"

Vessel Management Cell

Cadalmin-VI based at Cochin was utilised for collection of fish, prawns, molluscs, water samples and plankton in the inshore and backwaters of Cochin. The vessel was also

utilised for collection of fishes for various research projects at the new Mariculture Laboratory at Calicut. At Vizhinjam, the vessel was utilised for collection of ornamental fish and for launching of artificial reef. At Mandapam, the *Cadalmin-II* and *Sagitta* were utilised for collection of seaweeds and hydrographic data. *Sagitta* was also utilised to conduct EIS of the Sethusamudram project, a consultancy programme of CMFRI at Tuticorin. The vessel staff at Madras was fully utilised for various consultancy projects connected with environmental studies in the Bay of Bengal and Andaman sea. *Cadalmin III* at Madras is being decommissioned. Steps were taken to carry out repairs of *Cadalmin-IV* at Tuticorin. Steps were taken to procure new marine engines for the vessel *Seasearch* at Mangalore and for the *skiff* at Cochin.

The 107' steel trawler *R.V. Skipjack* was decommissioned and auctioned. VMC is also actively involved in the various DOD projects: Studies on Deep Scattering Layer, Investigations on the Toxic Algal Blooms of the EEZ of India and Stock Assessment, Biology, Resource Mapping of depsea fishes, shrimps, lobsters and cephalopods in the EEZ of India.

The Official Language Implementation Programme

During the year under report, a total of 697 Hindi letters were received of which 489 were replied in Hindi and reply was not necessary for the remaining letters. 436 documents coming under section 3(3) of the Official Language Act were issued in bilingual form. During the year 16% of correspondence was made in Hindi. The progress made in Hindi implementation programme was reviewed at the meetings of the Official Language Implementation Committee. Two meetings of the Cochin Town Official Language Implementation Committee were conducted.

संयुक्त हिन्दी सप्ताह समारोह - 1998
JOINT HINDI WEEK CELEBRATION - 1998
COCHIN TOWN OFFICIAL LANGUAGE IMPLEMENTATION COMMITTEE
C.M.F.R.I

Shri. L. Kuriakose, Commissioner of Income Tax inaugurating the Cochin TOLIC Joint Hindi Week Celebrations 1998

Hindi Week was celebrated at Headquarters and Regional/Research Centres from 14.9.1998 to 19.9.1998.

A Seminar was organised in Hindi on 3.3.1998 on 'Changing Scenario in Marine Fisheries and New Dimensions'; 8 research papers were presented and they were

published in Hindi. Two Hindi workshops were conducted for the Ministerial staff of Headquarters in January and July; 27 staff participated.

During the year, abstracts of 8 M.F.Sc. theses were written in Hindi. Two issues of '*Rajbhasha* Circular', six issues of MFIS with Hindi summary, two issues of Newsletter bilingually and Annual Report 1997-98 with Hindi summary were published. A total of 19 books were added to the Hindi Library.

Special efforts of the year

1) An All India *Rajbhasha* Contest based on the Hindi periodical '*Rajbhasha* Circular' was conducted for the staff at Headquarters and outstations. The top scorers of Headquarters and 12 outstations were given prizes.

2) The Hindi Week, jointly with Cochin TOLIC was celebrated at the Institute during 16th to 25th November, 1998.

3) In order to highlight the constitutional and legal provisions to promote the use of Hindi as Official Language the Institute sponsored the Official Language Poster Competition.

4) An intensive *Pragya* training course was conducted at CMFRI from 12.11.1998 to 1.12.1998. 26 staff from various Central Govt. Offices at Kochi including 6 staff of CMFRI attended the course.

5) A 'Functional Hindi Training Programme' was organised at the Veraval Centre.

6) A meeting in Hindi on "Research and Management in fish production sector" was organised at the Mumbai Research Centre of CMFRI for the fishermen at Versova.

RESEARCH ACHIEVEMENTS

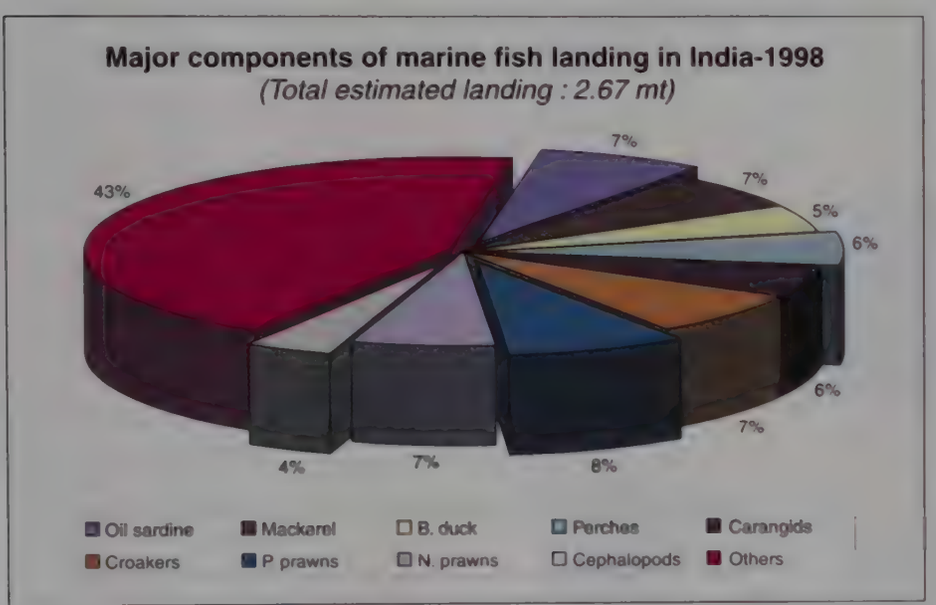
I. FISHERY RESOURCES ASSESSMENT DIVISION

ASSESSMENT OF EXPLOITED MARINE FISHERY RESOURCES (FSS/FRA.1.1)

K.N.Kurup, K.Balan, K.S.Scariah and K.Vijayalekshmi

Marine fish production in India during 1998

The marine fish production in India during 1998 was provisionally estimated at 2.67 million tonnes which is 2.12 % less than the estimated production of 2.73 million tonnes of 1997. The pelagic group formed about 49.2% of the total landings and demersal finfish, crustaceans and molluscs together formed 50.8%. The landings by mechanized and motorized units together accounted for about 92% of the total landings and those by nonmechanized and nonmotorized units 8%.



The salient features of marine fish landings in the country during 1998 in comparison to 1997 are:

- 9% decline in the oil sardine landings , the estimate for 1998 being 203,000t.
- 47.9% increase in *Coilia* landings with the catch estimated at 46,000t.
- 17.8% increase in the catfish landings with annual landings estimated at 53,000t.
- 17.9% increase in the Bombay-duck landings with the catch estimated at 123,000t.
- 12.0% increase in the threadfin bream landings, the estimate for 1998 being 81,000t.
- 13.2% increase in nonpenaeid prawn landings with the landings estimated at 174,000t.
- 2.9% increase in the penaeid prawn catch with the year's landings estimated at 215,000t.

MARINE FISH PRODUCTION (TONNES) IN INDIA DURING 1997 AND 1998

Name	1997	1998
PELAGIC FINFISH		
CLUPEOIDS		
Wolf herring	18448	19527
Oilsardine	223879	203800
Other sardines	120412	100005
Hilsa shad	28884	17206
Other shads	11620	14982
Anchovies	0	4
Coilia	31293	46268
Setipinna	2871	2773
Stolephorus	57479	72598
Thrissina	19	5
Thryssa	46358	42208
Other clupeoids	54315	52285
BOMBAY-DUCK	104153	122803
HALF BEAKS&FULL BEAKS	3988	5926
FLYING FISHES	173	3320
RIBBONFISHES	174746	113783
CARANGIDS		
Horse Mackerel	19493	25408
Scads	38829	53948
Leather-jackets	7180	6987
Other carangids	74465	61153
MACKERELS		
Indian mackerel	223682	177172
Other mackerels	18	4
SEERFISHES		
S. commerson	26712	32181
S. guttatus	14255	22561
S. lineolatus	901	107
Acanthocybium spp.	21	22
TUNNIES		
E. affinis	19167	15451
Auxis spp	8754	7679
K. pelamis	1571	1037
T. tonggol	5221	4751
Other tunnies	12298	10766
BILLFISHES	3462	3337
BARRACUDAS	13419	21697
MULLETS	5867	7397
MISCELLANEOUS	48351	44609
TOTAL PELAGIC FINFISH	1402304	1313760

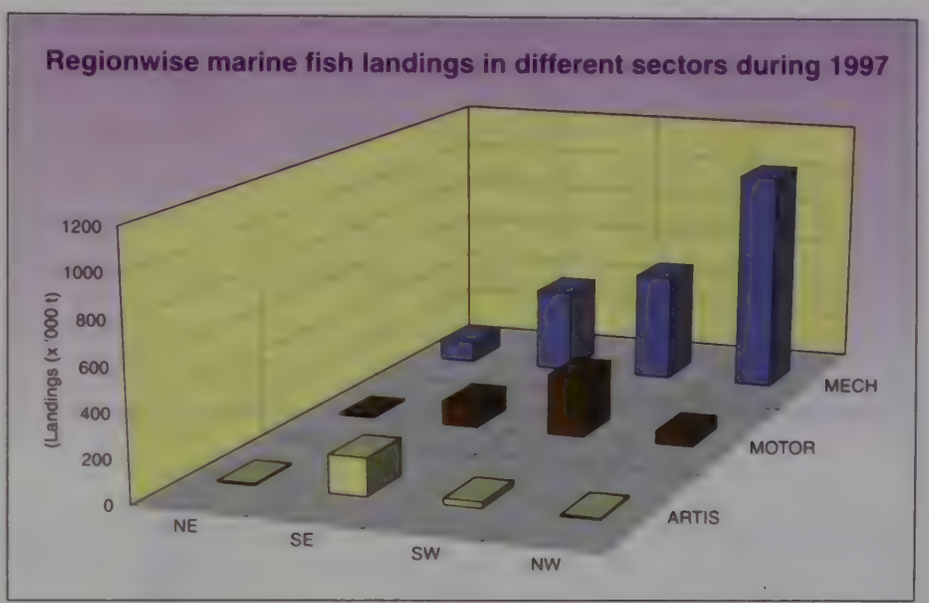
Name	1997	1998
SHELLFISH		
CRUSTACEANS		
Penaeid prawns	208809	214741
Non-penaeid prawns	153636	173942
Lobsters	2787	2611
Crabs	44963	34276
Stomatopods	92611	72600
MOLLUSCS		
Cephalopods	114079	107005
TOTAL SHELLFISH	**616885**	**605175**
DEMERSAL FINFISH		
ELASMOBRANCHS		
Sharks	44919	47520
Skates	3469	3331
Rays	26916	24411
EELS	7792	9573
CATFISHES	44684	52649
LIZARD FISHES	20624	24102
PERCHES		
Rock cods	15396	18570
Snappers	5336	5684
Pigface breams	14282	11694
Threadfin breams	72281	81228
Other perches	49929	36842
GOATFISHES	11059	15765
THREADFINS	10911	9346
CROAKERS	158270	199740
SILVERBELLIES	66426	56528
BIG-JAWED JUMPER	7386	9121
POMFRETS		
Black pomfret	13377	17386
Silver pomfret	31590	31372
Chinese pomfret	846	577
FLAT FISHES		
Halibut	2455	2103
Flounders	154	336
Soles	49277	44378
MISCELLANEOUS	49662	47293
TOTAL DEMERSAL FINFISH	707041	749819
GRAND TOTAL	**2726230**	**2668494**

- Decline of 46,000t in mackerel landings (21.0%)

REGIONWISE LANDINGS

Northeast Region : The landings in the Northeast region registered an increase of about 10,800t over that of the previous year. The principal components were Bombay-duck (16,000t), catfishes (9,400t), nonpenaeid prawns (8,900t), crabs (1200t), oilsardine (700t), other sardines (4,300t) and *Coilia* spp (4.,900t). Compared to the previous year, *Hilsa* shad declined by about 11,600t. However, the landings of Bombay-duck registered an increase of about 10,000t, the catfishes 770t, nonpenaeid prawns 6400t, crabs 200t, oil sardine (200t) and *Coilia* spp (1400t).

Southeast Region: The estimated landings in 1998 from this region was 6.8 lakh t; a decline of 60,600t from that of the previous year. An estimated 24,900t of elasmobrachs was landed in 1998 which showed a decline of 9200t. Oilsardine catch decreased by about 6700t from the 111,500t of the previous year. Other sardine landing was estimated at 57,000t,



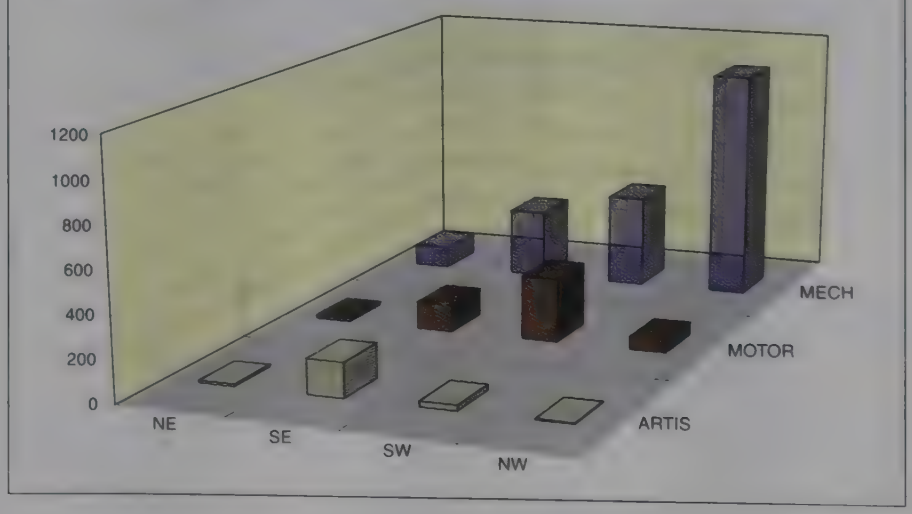
Regionwise marine fish production in India during 1998

Region	Estimated production (tonnes)	% in the all India total
1. Northeast (West Bengal & Orissa)	131,421	4.9
2. Southeast (Andhra Pradesh, Tamil Nadu & Pondicherry)	626,477	23.5
3. Southwest (Kerala, Karnataka & Goa)	757,936	28.4
4. Northwest (Maharashtra & Gujarat)	1118,846	41.9
5. Lakshadweep & Andamans	33,804	1.3

which was about 24,000t less than that of the previous year. However the landings of shads (other than *Hilsa* shads) increased marginally by about 4,000t from about 5,500t during the previous year.

An increase of about 9,000 t was observed in the landings of whitebait from about 24,000 t during the previous year. Landings of halfbeaks and fullbeaks increased marginally by about 2000t and those of carangids decreased by about 5500t over those of previous year. A significant decrease was noticed in the landings of silverbellies from about 53,000 t in 1997 to about 45,000 t during this year. Mackerel catch decreased significantly from about 39,000 t during 1997 to 31,000 t in 1998. The landings of penaeid prawns increased to about 48,000 t during 1998 from about 42,000 t during 1997. Cephalopod landings decreased by about 2700 t from the 12,000 t during the previous year.

Regionwise marine fish landings in different sectors during 1998



Southwest Region: The total landings decreased by about 71,000 t from that of the previous year. Among the major groups, oilsardine, perches, mackerel , penaeid prawns, stomatopods and cephalopods recorded reduced landings. However, the landings of whitebait, perches and carangids were better.The decrease was noticed in the oil sardine fishery by about 14,000 t, the estimated landings being 98,000 t. However, landings of whitebait registered an increase of 6500t and threadfin breams of 5600 t. The landings of perches declined from about 72,500 t in 1997 to about 64,500 t in 1998. Croakers increased by about 4500 t over the previous year. The landing of ribbonfishes declined from about 28,000 t in 1997 to about 20,000 t in 1998. The landing of scads was 47,000 t which showed an increase of about 80% over that of previous year. The landings of carangids increased from 72,700 to 83,600 t over the previous year. There was a decline of about 33,000 t in the landings of Indian Mackerel (141,000 to 108,000 t) and soles of about 8000 t (32,000t to 24,000 t). The landings of penaeid prawns slightly declined by 1800 t from 68,600 t to 66,800 t during 1998. The catches of stomatopods declined by about 26,000 t (53,000 t to 27,000 t). The cephalopod landings decreased from about 51,000 t in 1997 to about 43,000 t during 1998.

Northwest Region

This region contributed maximum to the total landings in the country with the estimated landings of 11.2 lakh tonnes as against 10.6 lakh tonnes during 1997. The landings (102,000t) of Bombay-duck showed slight increase of about 5,000t and nonpenaeid prawns showed a significant increase of about 22,000t. The landings of ribbonfishes registered a decline of about 35,000t, the landings being 88,000t in 1998.The landings of croakers (141,000t) showed an increase of about 33,000t over that of previous year. The penaeid prawns registered a marginal increase of about 1,100t during the year, the estimate being 93,600t. The cephalopod landing was estimated at 59,000t during this year which was about 8,000t more than that in 1997.The landing of sharks in this region was to the tune of 33,000 t in 1998 which showed a significant improvement of about 9,000t.The landings of *Coilia* spp also registered increase of 11,000t from 26,000t in 1997.

Landings by Mechanized, Motorized and Artisanal Units

The landings of 24.2 lakh tonnes by the mechanized units accounted for about 73.2% of the total marine fish landings of the country during 1998 followed by the motorized (18.8%) and artisanal units (8.0%). Trawl, purseseine, gillnet and *dol*net were the major gears used by the mechanized units, ringseine and gillnet by motorized units and gillnet, shoreseine, boat seine and several others by the artisanal units.

STOCK ASSESSMENT TECHNIQUES IN MARINE FISH AND SHELLFISH RESOURCES AND MANAGEMENT (FSS/FRA/1.3)

M.Srinath and R.Venugopalan

A computer algorithm was developed to estimate the parameters of the discrete version of the Schaefer model in the non-equilibrium case, employing the Nelder-Mead minimization routine.

The catch and effort data of 1961-'97 period from Maharashtra were analyzed. The catch rates of some commercially important resources in the major fisheries were also analyzed. The MSY of all the resources in the state was estimated as 361,000 t with a confidence interval of 314,000 to 407,000 t.

The CPUE of the penaeid prawns, catfish and croakers showed an inverse relationship with the trawl effort. For these three resources, the equilibrium and non-equilibrium versions of the Schaefer model and the equilibrium version of the Fox's model were fitted. For the penaeid prawns and the catfish, a harmonic component to account for the cyclical variations in the catches was introduced in the non-equilibrium model. The

MSY, fMSY were estimated. The fitted models were validated through a failure index (F.I%). Higher the F.I, the poorer is the fit. The results are summarized in the following table.

MODEL	RESOURCE	MSY	fMSY	F.I
Non-equilibrium (Schaefer) model without harmonic component	Penaeid prawns	46	280	62
	Croakers	24	265	32
	Catfishes	46	24	11
With harmonic component	Penaeid prawns	49	273	38
	Catfishes	11	284	19
Equilibrium (Schaefer)	Penaeid prawns	51	297	41
	Croakers	25.3	289	40
	Catfishes	13.6	192	25
Equilibrium (Fox)	Croakers	25.2	303	20.4
	Catfishes	12.6	248	19.1

The deterministic, univariate and multivariate term series modelling approaches were evaluated on the basis of their efficiency with a view to modelling and providing operational forecasts of the quarterly commercial landings of seven species along with the total landings of Tamilnadu during 1975-'96. The analysis revealed that ARIMA models provided better fits to other sardines, croakers and silverbellies, besides the total landings. The WES model gave a better account of elasmobranchs, carangids and penaeid prawns. The HREG provided better explanation of the landings of the perches.

EVALUATION OF CHANGE IN THE PATTERN OF CATCH AND COMPOSITION OF MARINE FISHERY RESOURCES IN INDIA (FSS/FRA/1.19)

K.S.Scariah, K.N.Kurup, K.Balan, M.Srinath and K.Vijayalekshmi

Trend in the landings of the major marine fishery resources (elasmobranchs, catfish, Bombay-duck, perches, croakers, ribbonfish, carangids, pomfrets, mackerel, seerfish, penaeid prawns, nonpenaeid prawns and cephalopods) in Maharashtra was analyzed. The data on estimated landings from 1961 to 1997 were used for the study.

It was found that the major fishery resources could be grouped in 5 distinct clusters.

Cluster	Resources
I	Bombay-duck and nonpenaeid prawns
II	Pomfrets, elasmobranchs and catfish
III	Seerfish, penaeid prawns and croakers
IV	Perches, carangids, cephalopods and ribbonfish
V	Mackerel

Cluster I : Both the resources have been showing gradual declining trend in the landings since attaining their peaks (Bombay-duck during 1981 and the nonpenaeid prawns during 1972). The landings of Bombay-duck declined from a peak of about 82,000 t during 1981 to about 10,000 t in 1996 and the nonpenaeid prawns have declined from about 84,000 t in 1972 to low of about 15,000 t in 1995. These resources which together accounted for more than 50% of the total landings during the 1970s and 1980s, accounted for only 10% currently.

Cluster II : Showing a general increasing trend upto 1987, all the three resources of this cluster, suffered declining trend ; their relative contribution also exhibited a similar trend.

Cluster III : The landings of the three resources exhibited a general increasing trend from 1974 onwards. The penaeid prawns showed fluctuations in the landings from 1981 , so also the seerfish.

Cluster IV : The landings of these resources have significantly increased from 1981 onwards and these four resources exhibiting similar trend from 1981 onwards. These four resources together contributed relatively more than the hitherto dominant resources such as the Bombay-duck and the nonpenaeid prawns.

Cluster V : The mackerel stood as a group distinct from the other major resources. During 1961-'68, the landings were almost insignificant and shot upto about 21,000 t in 1969 again decreased to insignificant levels till 1988. In 1989, again shot the landing up to about 22,000 t and showed a general increasing trend latter with peak landings of about 38,000 t in 1996.

Thus, the analysis revealed that there was a tangible change in the composition of the total marine fish landings in Maharashtra. This may be attributed to gradual decline of the *dolnet* fishery and increase in the case of trawl fishery targeting economically more valuable fishery resources.

The tabulation and analysis of data of different seasons and gears in respect of Gujarat are in progress. The major groups identified are to be subjected to further analysis on the basis of gearwise and seasonwise landings. The collection of relevant details on technological changes in marine fisheries sector are also in progress. Further analysis would continue by taking all the relevant data.

MANAGEMENT INFORMATION SYSTEM IN MARINE FISHERIES (FSS/FRA/ST.1)

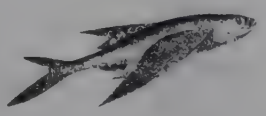
K.Balan, K.N.Kurup, K.S.Scariah, M.Srinath and K.Vijayalekshmi

The large volume of data generated through the survey programme of the Institute were fed into the computers installed at the Marine Data Centre on monthly zonewise formats. The fishery data in respect of all the geographical zones of the mainland were verified, coded and transferred to storage devices.

These stored data were analyzed and the results were promptly made available to various endusers. Software developed by the Data Centre were used for creation, updating, processing and retrieval of data/results. The supervision and co-ordination work in respect of data scrutiny, transfer and processing was attended during 1998-99 period. The information on districtwise, gearwise and specieswise marine fish landings were completed for the year 1998.

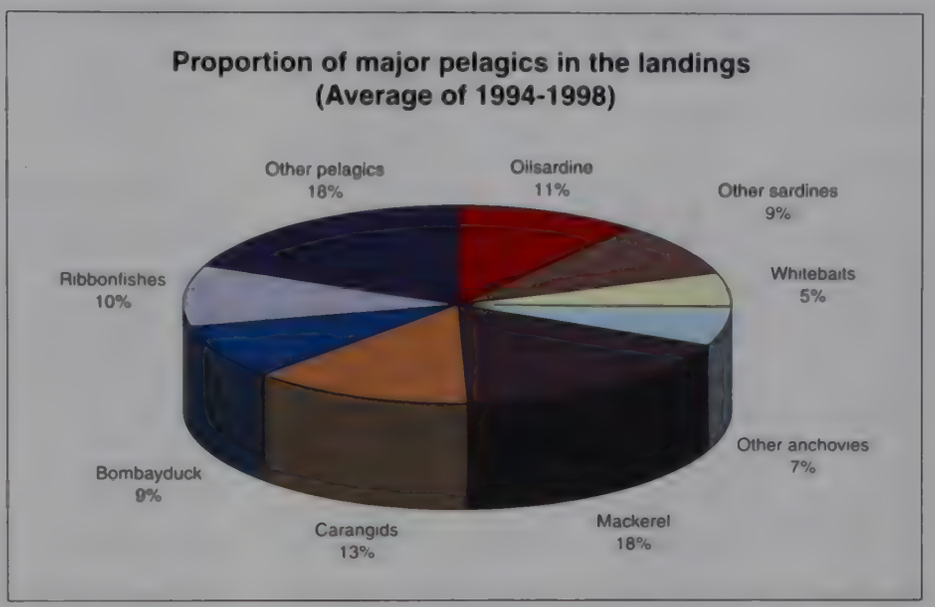
Additional data collected through survey programme on turtles was transferred to the computer and processed. Backup files were created on the magnetic tapes.

The course contents included theory and practical classes on elementary mathematics, differential calculus, elements of computers, descriptive statistics and statistical methods. An exposure on the use of computer softwares related to statistics was also offered for the benefit of trainees. The practical classes were conducted at the computer laboratory, using softwares such as ***statistica, mstac, msexcel*** **etc.**



II. PELAGIC FISHERIES DIVISION

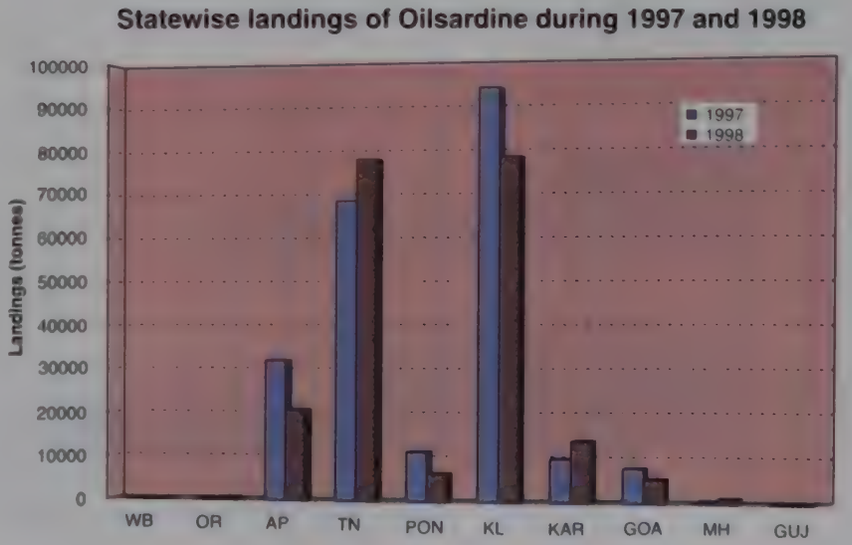
During 1998-99 the Pelagic Fisheries Division carried out investigations under eight Research Projects. Pelagic finfish production during 1985-1998 fluctuated from 0.78 mt in 1985 to 1.42 mt in 1998 forming 51.1% of the total marine fish production. A stagnation in the catch at 1.3 mt (annual) against an annual potential yield of 2.21 mt of pelagic resources from the Indian EEZ is discernible for the last eight years. About 66.4% of the production of pelagics in 1998 was obtained from the west coast, 31.9% from the east coast and the rest (1.7%) from the Island territories. Among the maritime states, Kerala ranked first, contributing 23.4% of the total pelagics, followed by Gujarat 21.6%, Tamilnadu 16.7%, Maharashtra 12.3%, Karnataka 11.1%, Andhra Pradesh 8.9%, Lakshadweep 3.0% and the rest from other States.



FISHERY AND RESOURCE CHARACTERISTICS OF *SARDINELLA* SPP. (PF/RE/1.1)

N.G.K.Pillai, U.Ganga, Prathibha Rohit, T.M.Yohannan, A.A.Jayaprakash and K. Dorairaj

After the fluctuating trend noticed in the mid-nineties, the oilsardine fishery showed an upward swing during the year 1995 along the west coast of India. The process was fast at centres along the south (Cochin, Calicut and Managalore), and slow in the north at Karwar. The production during the last 14 years varied from 0.47 lakh t in 1994 to 2.79 lakh t



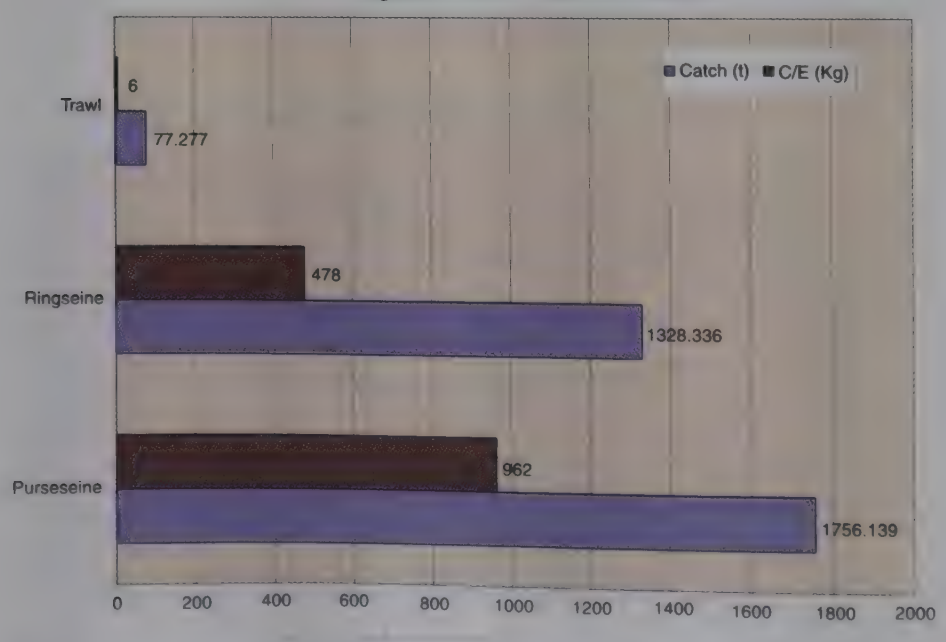
in 1989. During 1998, the production was 2.03 lakh t which is less by 8.5% over last year. The lesser sardine landing during the current year was 1.01 lakh t compared to 1.17 lakh t during the previous year.

Fishery

Data on the fishery and resource characteristics of *Sardinella* spp. were collected at Karwar, Mangalore, Calicut and Cochin along the west coast, and Tuticorin, Mandapam, Madras and Visakhapatnam along the east coast. At all the centres except Mangalore, Mandapam and Visakhapatnam the sardine landings registerd an increase as follows: Karwar 4184 t (+260%), Calicut 769 t (+21%), Cochin 3161 t (+62%), and Tuticorin 8319 t (+98%). The purseseines contributed 100% of the total sardine catch at Karwar, 85% at Mangalore and 55% at Cochin. Ringseines shared 2.2% at Mangalore compared to 99.8% at Calicut and 42% at Cochin. The trawls accounted for 2.2% at Mangalore, 2.4% at Cochin, 1.4% at Mandapam and 4.5% at Visakhapatnam. Gillnets were the sole gear at Tuticorin, while the gear shared 20% and 24% of the sardine catch at Mandapam and Visakhapatnam respectively.

At Mangalore, though the purseseine effort was less by 16%, the catch (7539 t) increased by 0.7% over the last year, while in the trawls there was a 15% reduction in effort with a consequent decline (52%) in the catch (176 t). The ringseine effort increased by 50% bringing 66% increase in the catch (195 t). At Cochin, the purseseine effort decreased by 29%, but the landings were high by 20% (1756 t). A similar trend was noticed in the trawl landings at this centre. On the other hand, a marginal increase in effort by 0.9% in the operation of ringseines yielded 1328 t, an increase of 62% over the previous year. The *Chalavala* landings at Tuticorin (901 t) was less by 8% with a reduction in effort input by 28% over last year. At Punnakayal the same gear landed 7419 t, the effort and landings indicated 55% increase. At Pamban, the trawl landings (35 t) were less (-99%) consequent on a reduction in effort (-54%). The gillnet catch (484 t) showed 113% increase for 46% increase in effort. Inspite of an increase in effort by

Catch and catch rate of oilsardine landed by Purseseine, Ringseine and Trawl at Cochin



129% in pairtrawling, the landings (434 t) dropped by 83%. But at Rameswaram the effort input increased by 249% and concomitantly landings by 419% (1450 t).

The highest c/e of 916 kg was realised by the purseseines at Cochin followed by 714 kg at Karwar and 495 kg at Mangalore. The ringseines also recorded a higher c/e of 478 kg at Cochin compared to 100 kg at Mangalore and 49 kg at Calicut. The trawls realised less than 5 kg along the west coast compared to 8-9 kg along the east coast. The c/e was 631 kg in pair trawling along southeast coast. The gillnets at Tuticorin showed a c/e of 81-88kg compared to 46 kg noticed at Visakhapatnam.

At Karwar and Calicut, the fishing season started by October and continued upto February/March, with a peak during November-January. Sardines were exploited throughout the year by one gear or the other at Mangalore/Malpe, Cochin and at east coast centres. Along the west coast the peak fishing took place from September-November compared to I and II quarters at Tuticorin; May to November at Mandapam; and IV and I quarters at Visakhapatnam.

In all the gears operated along the west and southeast coasts, oilsardine was the dominant species forming 50-100% of total sardines landed. In the purseseines at Karwar, trawls and ringnets at Calicut the species formed 100% compared to 86-92% in the pair trawls at Mandapam. Lesser sardines (*S.albella* and *S.gibbosa*) dominated at Mandapam Area while *S. gibbosa* and *S.sirm* formed the major species landed at Tuticorin. *S.fimbriata* and *S.gibbosa* dominated in the sardine fishery along the west coast.

Biology

Oilsardine of 105-205mm (modal length: 140) were exploited by the purseseines at Karwar, 85-205 mm (128 mm) at Mangalore

Length range (mm) and modal length (mm) of oilsardine landed by various gears at different Centres during 1998

Centres	Gear	Length range	Modal length
Karwar	PS	105-205	140
Tadri	PS	165-205	175
Mangalore	PS	85-205	125
	TR	120-195	170
	RB	105-150	125
Malpe	PS	100-210	140
	TR	155-190	175
	RB	110-200	125
Calicut	RS	90-205	180
Cochin	TR	115-215	180
	PS	105-215	145
	RS	50-210	70
Visakhapatnam	BS	70-200	85
	GN	130-195	170
	TN	155-200	170

PS - Purseseine
TR - Trawl
BS - Boatseine
GN - Gillnet
TN - Trawl
RB - *Ranibale*

and 100-210 mm (140 mm) at Malpe. The ringseine catch consisted of 105-150 mm (125 mm) at Mangalore, 110-200 mm (125mm) at Malpe, 90-205 mm (180mm) at Calicut and 50-210 mm (70mm) at Cochin. Relatively larger fishes were observed in trawls as: 120-195mm (170mm) at Mangalore, 155-190mm (175mm) at Malpe, 115-215mm (180mm) at Cochin and 155-200mm (170mm) at Visakhapatnam. In the boatseines 70-200 mm (91mm) were noted at Visakhapatnam. *S.gibbosa* of 85-165 mm were noticed in the *Chalavalai* at Tuticorin while 70-170mm were obtained in purseseines at Mangalore. *S.albella* of 85-145 mm were exploited at Mandapam.

There was good concentration of spawning population of oilsardine off Mangalore/ Malpe unlike that in the previous year where such concentration was observed off Cochin. Probably, the large concentration of young oilsardines off Cochin during July in 1998 is the result of the spawning success and survival of oilsardine recruited last year. But this year a shift was observed in the spawning ground towards north in the Malabar Upwelling Ecosystem. Along the east coast, at Visakhapatnam, it is the post spawners and new recruits that were exploited.

FISHERY AND RESOURCE CHARACTERISTICS OF ANCHOVIES (PF/RE/1.2)

R.Thiagarajan, M.Zaffar Khan, Prathibha Rohit, A.A.Jayaprakash, K.Dorairaj and H.Mohammed Kasim

During the last one and a half decade the anchovies recorded the highest production of 1.65 lakh t in 1991, but further showed a declining trend and appeared to have stabilized between 1 lakh t and 1.6 lakh t. The production of 1.38 lakh t in 1997 is only a marginal improvement by 3.8% over 1996, but it further improved to 1.63 lakh t in 1998. Statewise, the highest contribution of 21.9% was from Kerala followed by 19.7% from Gujarat and 19.5% from Tamilnadu.

Fishery

At Mangalore, the landings improved from 4715 t in 1997 to 6225 t (+32%) in 1998. At Cochin, 184 t were landed against 101 t of the previous year. At Vizhinjam, 789 t were landed against 398 t during 1997. Along the east coast, at Kakinada the catch was 1155 t. A production of 184 t at Cochin is an improvement over the preceding year, but is relatively low compared to the landings recorded during the early nineties.

At Mangalore/Malpe though the effort input has gone down in all the gears, the catch indicated an increase. In the purseseines the effort (15232 units) was down by 10% but the catch (4198 t) improved by 71%. The effort (58061) and catch (2026 t) in trawls decreased by 2.4% and 11% respectively. The ringseines registered 60% increase in catch against 5.6% decrease in effort. At Cochin, the effort input by purseseines and trawls

declined by 52% and 29% but the landings improved by 100% and 5% respectively. In the ringseines the decrease in effort (6%) though marginal, resulted in 138% increase in the catch. The highest c/e of 276 kg was observed in the purseseines at Mangalore followed by 49kg by ringseines at Cochin. The trawls recorded a highest c/e of 35 kg at Mangalore/ Malpe followed by 18.7 kg at Kakinada and 2.5 kg at Cochin.

In the purseseines at Mangalore the IV quarter was highly productive (46%) followed by I (41%), II (12%) and III (1%) quarters. But in trawls the first quarter (76%) was highly productive followed by IV (15%) and 11 (9%) quarters. At Cochin, the trawls landed (50t) anchovies only during January, September, November and December with a highest catch of 34 t in September. The purseseine also landed a catch of 5 t in September and

Length range (mm) and modal length (mm) of dominant species of anchovies landed by various gears at different Centres during 1998

Centre	Gear	Species	Length range	Modal length
Mumbai	TN	*Coilia dussumieri*	30-209	140
Mangalore	TN	*S. devisi*	45-95	85
	TN	*S. bataviensis*	55-105	90
	TN	*S. macrops*	70-75	72
	PS	*S. devisi*	50-95	85
Cochin	RS	*S. buccaneeri*	55-70	60
	RS	*S. commersonii*	55-100	70
	TN	*S. devisi*	60-100	80
	TN	*S. commersonii*	50-130	95
	PS	*S. commersonii*	80-95	85
	PS	*S. buccaneeri*	80-95	80
Kakinada	TN	*S. devisi*	40-95	65
	TN	*S. bataviensis*	45-135	65
	TN	*S.commersonii*	75-150	120
	TN	*S. indicus*	65-155	90
Mandapam	SS	*S. indicus*	55-125	70
	TN	*S. commersonii*	90-135	125
	TN	*S. indicus*	75-135	130

TN - Trawl net, RS - Ringseine, PS – Purseseine, SS - Shoreseine

no landing was recorded during the rest of the period. In the ringseine the season was from April to September with a peak catch of 78 t in July. At Kakinada, the trawls recorded a highest catch during II quarter (36%), followed by IV (24%), I (22%) and III (18%) quarters.

S. devisi was the dominant species in all the gears at Mangalore. In the purseseines, the species formed 90% followed by *S. bataviensis* (9%). *S. macrops* and *S. buccaneeri* formed the rest. In the trawls at Mangalore and Malpe *S. devisi* constituted 85% and 77% respectively. *S. bataviensis* formed 14% at the former centre and 8% at the latter centre. Other species, each contributed to less than 10%. *S. devisi* was the dominant species in the trawls at Cochin. But in the ringseines *S. commersonii* dominated which was unusual. This is because the regular fishery for *S. macrops* has been a failure. At Kakinada, *S. bataviensis* (48.5%) followed by *S. Commersonii* (20%) and *S. devisi* (12.2%) constituted the fishery.

Biology

S. devisi of 50-95 mm in the purseseines, 45-95 mm in trawls, *S. bataviensis* 55-105 mm in trawls were observed at Mangalore. At Malpe, both species from 35 mm and above were represented. At Cochin, *S. devisi* of 60-100 mm were noticed in trawls. *S. commersonii* of 80-130 mm in the purseseines, 50-100 mm in trawls, and 55-100 mm in ringseines were encountered. *S. buccaneeri* occurred in the size range of 55-70 mm in ringseines and 80-95 mm in purseseines.

Along both east and west coasts, most of the anchovies indicated a spawning season extending from October to May. While some of them were with peak spawning activity during the post-monsoon period, others were more oriented to a premonsoon peak.

FISHERY AND RESOURCE CHARACTERISTICS OF SEERFISHES (PF/RE/2.1)

C.Muthiah, B. Manoj Kumar, T.M. Yohannan, N.G.K. Pillai and H.Mohammed Kasim

The seerfish landings, though fluctuating gradually increased from 0.35 lakh t in 1985 to a peak of 0.55 lakh t in 1998. Investigations on the fishery and resource characteristics of seerfishes were carried out from Veraval, Mangalore, Calicut and Kochi on the west coast and Tuticorin, Madras, Kakinada and Visakhapatnam along the east coast. Work at Kakinada was initiated on April 1998.

Fishery

Seerfish landing by gillnet and trawl at the centres along the west coast and by gillnet, trawl and hook & line at the east coast centres showed marginal improvement (10%) as compared to that in 1997. There was an increase in production, varying from 10.6% (Calicut) to 154.6% (Kochi) in all centres except Veraval and Tuticorin where, the

landing declined by 30% and 12% respectively. The catch at different centres ranged from 131 t (Calicut) to 1236 t (Veraval). There had been better abundance of the resource in the gillnet and trawling grounds off Mangalore-Malpe, Kochi and Madras and in the gillnet fishing grounds off Visakhapatnam while, it was poor in the gillnet and trawl fishing grounds off Veraval and hook & line grounds off Tuticorin.

Peak production of seerfish was recorded in the Ist quarter (35%), followed by the IVth quarter (28.4%), IIIrd quarter (19.2%) and IInd quarter (17.2%). Along the west coast at different centres maximum catches were recorded during Ist quarter (40.5%) followed by the IIIrd quarter (33.7%). In the east coast, IIIrd quarter (32.6%) registered high production followed by Ist quarter (25.8%) and IInd quarter (22.7%) at different centres. Peak catches were recorded in October at Veraval and Kochi, December at Visakhapatnam, February at Madras, March at Mangalore, April at Calicut, July at Kakinada and August at Tuticorin.

As in the previous year, gillnet was the major gear contributing 56.9% followed by trawl 34.3%, hook & line 8.3%, purseseine 0.4% and indigenous gears 0.07%.

Gillnet was the dominant gear at Veraval (71.3%), Kochi (93.4%), Tuticorin (51.3%) and Madras (43.4%). The total effort from all the eight centres increased marginally (1.3%) as compared to last year. The effort at different centres varied from 2,977 units (Calicut) to 31,194 units (Veraval). The C/E in large meshed gillnet ranged from 21.2 kg (Calicut) to 71.6 kg (Madras). The catch was highest at Veraval (881 t) and lowest at Visakhapatnam (42.8 t). The C/E had improved at Mangalore (25.3%), Kochi (155%), Tuticorin (48%) and Madras (49.2%), while it declined at Veraval (22.3%) and Calicut (31.6%). Seerfish constituted 23.9% in the total catch of gillnet at Veraval, 23.9% at Mangalore-Malpe, 21.9% at Kochi and 16% at Visakhapatnam.

Trawl was the chief gear for seerfish fishery at Mangalore-Malpe (589 t, 55.6%) and Calicut (68.2 t, 51.9%). In other centres the catch fluctuated from 32.2 t (Kochi) to 354.3 t (Veraval). The effort input at individual centres varied from 10,554 units at Calicut to 70,531 units at Veraval. C/E was highest at Mangalore-Malpe (23.7 kg in multiday trawlers) and lowest at Kakinada (1.3 kg). The C/E had improved at Mangalore-Malpe (135.8%), Kochi (841.2%) and Madras (74.4 %) whereas, it declined at Veraval (17%) and Tuticorin (28.3%). Seerfishes formed 0.6% of the total fish catch by trawls at Veraval, 1.3% at Mangalore-Malpe and 0.3% at Kochi.

Hook and line was the prime gear for seerfish production at Visakhapatnam (137 t, C/E = 5.4 kg) constituting 43% of the total catch of the gear. The catch and catch rate were high at Madras (142 t; C/E = 23.6 kg) and low at Tuticorin (76 t; C/E = 6.5 kg). The

effort was highest at Visakhapatnam (25,593 units) followed by Tuticorin (11,704 units) and Madras (6,012 units).

Purse seiners landed 17.5 t at Mangalore-Malpe and 1.2 t at Kochi which was less by 69.2% at the former and 3.5% at the latter centres. Indigenous gears landed about 2.8 t at Mangalore-Malpe and 0.2 t at Calicut as compared to 0.8 t and 20.8 t respectively in 1977.

The fishery was constituted by four species, *Scomberomorus commerson, S. guttatus, S. lineolatus* and *Acanthocybium solandri* in the proportion of 64.4%, 34.9%, 0.3% and 0.4% respectively. As compared to 1997-98, the percentage of king seer landing increased by 4.5% and this loss was gained by that of the spotted seer. The king seer dominated in all gears and all centres except at the northern centres at Veraval, Kakinada and Visakhapatnam where the spotted seer was dominant.

Biology

The length range of *S. commerson* was 26-132 cm in the large meshed gillnet with dominant modes at 62 cm (Veraval), 52 cm (Mangalore-Malpe), 60 cm (Calicut), 70-75 cm (Kochi) and 74 cm (Tuticorin). In the small meshed size gillnet *podivalai* at Tuticorin and bottom-set gillnet at Kakinada the size range was 12 to 66 cm and 16 to 128 cm with modal size at 40 cm and 26 cm respectively. The fishery was supported by 46-112 cm (99.2%) at Veraval, 36-96 cm (97.7%) at Mangalore-Malpe, 34-88 cm (97.9%) at Calicut, 44-144 cm (98%) at Tuticorin and 34-104 cm (96.5%) at Madras. The proportion of youngfish (< 34 cm size) component was high in *podivalai* at Tuticorin (52.5%) and in the bottom set gillnet at Kakinada (64.9%). In trawl, the size range was 10-106 cm with dominant modes at 60 cm (Veraval), 24 cm (Mangalore-Malpe), 25-30 cm (Kochi), 50 cm (Tuticorin) and 12 cm (Kakinada). The youngfish exploitation was higher at Kakinada (92.8%), Mangalore-Malpe (77%) and Tuticorin (40.9%) indicating the threat of growth overfishing. The size-range was relatively high in hook & line (40-138 cm) with dominant modes at 62 cm at Tuticorin and 68 cm at Chennai. In purseseines catch at Kochi , small sized specimens (10-50 cm) constituted the catch.

The size range of *S. guttatus* in gillnet was 12-70 cm with dominant modes at 42 cm (Veraval and Mangalore-Malpe), 52 cm (Madras) and 16 cm (Kakinada). In the trawl, the size ranged from 8 to 62 cm with dominant mode at 42 cm (Veraval), 34 cm (Mangalore-Malpe), 36 cm (Madras) and 12 cm (Kakinada). Overall, the fishery was supported by 12-68 cm in gillnet (98%) and 8-54 cm in trawl (65-99%). Youngfish (< 18 cm size) were caught more abundantly at Kakinada by both gillnet (46.4%) and trawl (48%), indicating high fishing pressure on the stock.

FISHERY AND RESOURCE CHARACTERISTICS OF TUNAS, TUNA-LIVEBAITS AND BILLFISHES (PF/RE/2.2)

P.P.Pillai, B.Manoj Kumar, M.Zaffar Khan, C. Muthiah, T.M.Yohannan, N.G.K.Pillai, G.Gopakumar, H.Mohammed Kasim, M. Sivadas and A.K.V. Nasser

The all India tuna landings after a highest ever record of 0.52 lakh t in 1990 fluctuated around 0.40 lakh t till 1998. Studies on the fishery and resource characteristics of tunas, tuna-livebaits and billfishes were carried out at Veraval, Mumbai, Mangalore, Calicut, Cochin, Vizhinjam, Tuticorin, Madras, Kakinada and Minicoy.

Fishery

The catch and percentage increase/decrease over to the previous year were as follows: Veraval 851.6 t (-52.1%), Mumbai 429.2 t (-41.2%), Mangalore 1121.6 t (+196.8%), Calicut 51.3 t (-34.2%), Cochin 1010 t (-28.3%), Vizhinjam 4600.4 t (+67.4%), Tuticorin 952.2 t (+194.6%), Madras 319.5 t (+21%), Kakinada 17.9 t (+31%) and Minicoy 1030.8 t (+49.6%). Tunas and billfishes formed between 0.7% in hooks and line fishery at Tuticorin and 99.7% in pole and line fishery at Minicoy. The catch per unit effort in the gillnet fishery varied from 2.8 kg at Kakinada to 138.6 kg at Cochin. In the pole and line fishery at Minicoy (Lakshadweep) it was 366.9 kg in 1998. Because of the calmness of sea during this year, the pole and line fishing resumed after the monsoon in early August. At Agatti, the monsoon fishery came to an end as early as in August due to the resumption of pole and line tuna fishery. At Tuticorin, some trawlers (25 ft) were converted for drift gillnet operation throughout the year for tunas keeping the Tharuvaikulam as their landing centre.

Among tunas, *E. affinis* was the major species except at Vizhinjam and Minicoy. At Veraval this species formed 36.7%, 56.6% at Mumbai, 57.04% at Mangalore (DGN), 70.4% at Mangalore (PS), Cochin (DGN) 56.7%, Cochin (PS) 78.9%, Calicut (DGN) 71.1%, Tuticorin (DGN) 41%, Tuticorin (POD) 84.4%, Tuticorin (H&L) 98.4%, Madras (DGN) 69.3%, and Kakinada (DGN) 55.4% of the tuna catch. At Vizhinjam 45.5% of the catch was constituted by *A. rochei* followed by *E. affinis* (25.4%). At Minicoy in pole and line fishery, *K. pelamis* was dominant forming 82.8% followed by *T. albacares* (16.5%), *E. affinis* (0.2%) and *Auxis* spp. (0.5%). *K. pelamis* and *T. albacares* occurred in all the months in the fishery. The total billfish landing in 1998 was 212 t which was 70% more than that in 1997. The major billfish species was *Istiophorus platypterus*. *Makaira indica* and *Xiphias gladius* also contributed to the billfish catch at different centres along the mainland of India.

Biology

Biological studies were carried out on *K. pelamis* at Minicoy. Of the estimated total fishes, 44% was represented by size groups upto 44 cm, whereas 73.7% was by 50 cm.

Length range (cm) and modal length (cm) of dominant species of tunas landed by various gears at different Centres during 1998

Centre	Gear	E.A	A.T	T.T	T.A	K.P
Veraval	GN	26-68 (56)	20-46 (38)	32-88 (66)	76-100 (88)	
Dhamlej	GN	30-66 (56)	28-46 (38)	50-92 (84)	70-102 (88)	
Mumbai	GN	26-68 (48)	0	0	0	
Mangalore	PS	32-58 (44)	38-48 (40)	56-58 (56)	0	
	GN	32-68 (36)	28-50 (36)	28-50 (38)	0	
Malpe	PS	42-62 (52)	0	0	0	
	GN	30-68 (42)	30-50 (42)	30-50 (36)	0	
Kaup	GN	30-48 (32)	38-50 (40)	30-64 (46)	0	
Calicut	GN	30-64 (46)	0	0	0	
Cochin	GN	36-64 (50)	20-36 (28)	40-64 (54)	60-100 (86)	44-68 (58,60)
	PS	26-40 (32)	0	0	0	
Vizhinjam	GN	22-56 (38)	30-44 (32)	0	0	
Tuticorin	PAR	22-72 (54)	22-44 (38)	0	0	
Madras	GN	30-66 (44)	0	0	0	
Kakinada	GN	30-68 (52)	30-42 (36)	0	0	
Minicoy	P&L	0	0	0	28-78 (50)	24-68 (40,48)

GN - Gillnet
PS - Purseseine
PAR - Large meshed drift gillnet

E.A - *E. affinis*
A.T - *A. thazard*
T.T - *T. tonggol*

T.A - *T. albacares*
K.P - *K. pelamis*
P&L - Pole and line

Fishes with empty stomachs were maximum followed by 1/2 and 3/4th full conditions. Natural food items comprised of fishes, prawns and squid. Fishes observed were flying fish, *Decapterus* sp., balistids and *Stolephorus* sp. Prawns were constituted mainly by *Thalassocaris* sp. and *Leptochela* sp. The sex ratio was almost equal in most of the months. Among mature fishes, partially spent ones were dominant in all the months. The fishes below 50 cm were invariably immature.

Baitfish fishery

The baitfish catch in 1998 at Minicoy was 6.5 t with a C/E of 3.0 kg. Clupeids formed 65% of the catch. Caesionids and apogonids which formed 28% and 7% respectively were noticed in the first half of the season. The total catch during the postmonsoon period was only 3.2 t whereas it was 5.6 t in 1997. The temporary cessation of monsoon during August coupled with the availability of tuna had made the resumption of live-bait fishing very early this year. In November and December acute shortage of live bait was felt. It was observed that about 5 kg of *Spratelloides gracilis* was obtained after 8 hauls expending about 4 hours, whereas in normal situation this much quantity could be obtained by one or two hauls. As a result of spending too much time on bait fishing, the return of boats after tuna fishing was belated.

FISHERY AND RESOURCE CHARACTERISTICS OF MACKEREL (PF/RE/2.3)

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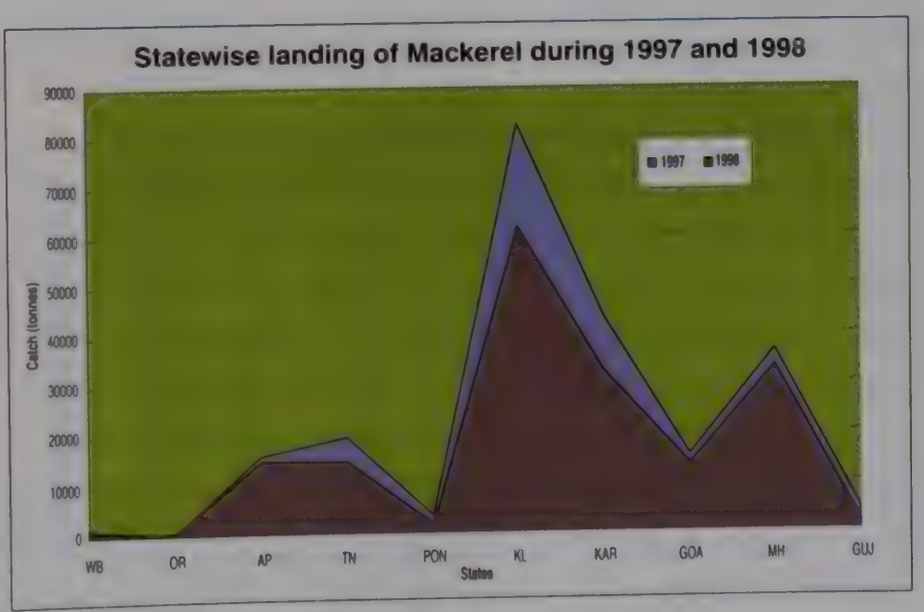
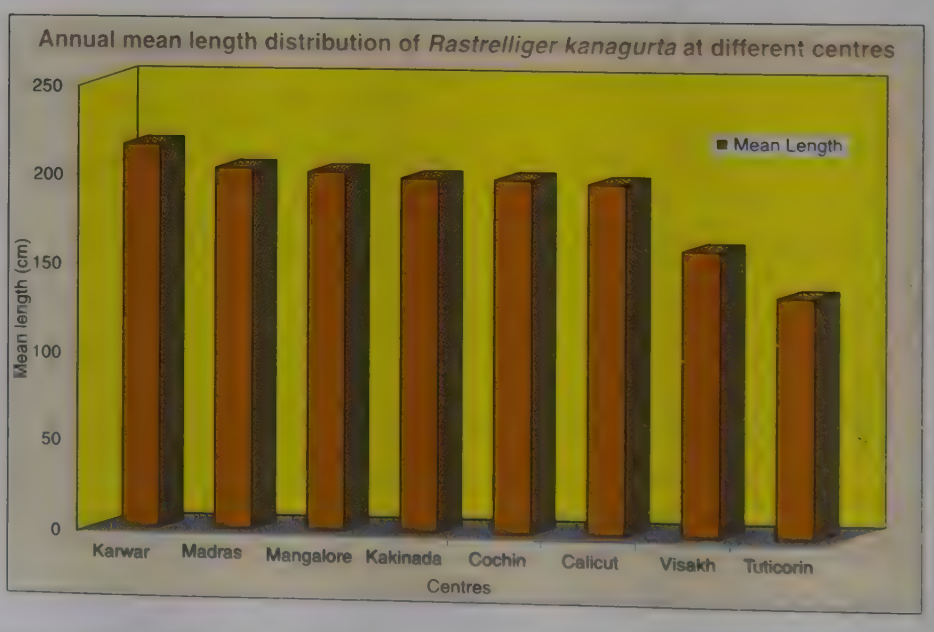
The mackerel production after reaching a peak of 2.9 lakh t in 1989 started showing downward trend. However, 2.7 lakh t were landed during 1996, and subsequently declined to 2.28 lakh t in 1997 and to 1.8 lakh t in 1998. Intensification of exploitation of mackerel by more efficient fishing methods does not seem to affect



the resource adversely. The fishery showed improvement at Karwar (6258t), Mangalore 10794t (+5.3%), Vizhinjam 1545t (+91%), Madras 808t (+47%) and Kakinada 3214t. On the other hand the trend was reverse at Calicut 768t, Kochi 3697t (-68.5%), Tuticorin 275 t (-29%) and Visakhapatnam 119t.

The fishing pattern was observed to be almost similar i.e. at Karwar, Mangalore, Calicut, Cochin, Vizhinjam and Tuticorin as well as Madras, Visakhapatnam and Kakinada. Karwar and Mangalore had a comparatively shorter period of active fishery - September to November. Here the fishery was completely dominated by purse seines (92.67% of the total mackerel catch). In the Calicut-Cochin Area, landings by purseseines/ringseines indicated a peak during September-November, whereas in the trawls the major peak was during summer (May-June). 42.62% of the total mackerel catch in this area was contributed by trawls, a recent development caused by the intensification of trawling in the deeper waters during summer. This has revealed its movement to the deeper waters as the summer advances thereby reducing the availability of the shoals to surface gears. At Vizhinjam and Tuticorin, the resource has been exploited to the maximum around June. At Vizhinjam the major gear is the driftnet whereas, at Tuticorin bulk of the catches were taken by trawls.

Along the Madras-Visakhapatnam-Kakinada Area peak catches were recorded in February. The fishery is sustained throughout the year and monthly fluctuations are not sharp. In Madras and Kakinada, trawl nets landed the bulk of the catch whereas, in Visakhapatnam trawl nets and gillnets were equally important. The bottom trawl is slowly emerging as an important gear in the mackerel fishery during the demersal phase in its life history during summer. Along the west coast, the demersal phase of the fish protect the resource from over-exploitation by pelagic gears by the end of the post monsoon period. The fish is caught by trawls in the summer from areas deeper than 30 m. The recent extension of trawling grounds to deeper areas, and the large scale occurrence of mackerel in this gear indicate that the demersal phase is spent in deeper waters beyond the



traditional trawling grounds.

One positive change in the mackerel fishery in India during 1998 was the increased mean length of the fish in the commercial catches. Low mean lengths were recorded only at Visakhapatnam and Tuticorin. At Visakhapatnam the trawl used to bring juveniles in the earlier years also. During this year, boatseines and gill nets also brought juveniles in abundance. It is surprising that the lowest mean length was recorded in trawl net and gill net catches.

The comparative increase of mean length along the west coast was not the result of any kind of conservation measures. There was a general delay in the commencement of active fishery especially at Calicut-Cochin area. The peak fishery used to take place during August-September in this area, but, in 1998, the fishery was better in October-November. The 52 cm rainfall in September 1998 is a record since 1985. Continuation of intensive rainfall to September/October is observed to cause a delay in the commencement of active mackerel fishery. As the intensive spawning of mackerel occurs around May, and recruitment by July/August, any delay in the commencement of the fishery allow the growth of the new recruits. The summer fishery for mackerel exploit mainly post spawners. However, the situation has put a control over the emerging growth overfishing in the mackerel fishery except in Visakhapatnam and Tuticorin.

Juveniles of mackerel were first caught in September in Karwar; at Mangalore an early recruitment was observed in January/February; peak recruitment was observed at Calicut in September/October. At Cochin it was observed in June-August as well as in November. At Tuticorin its recruitment was observed in May/June, at Madras in April and July-August, and at Visakhapatnam in April-May and October-November. The indications are that there are local populations along the east and west coasts of India with large scale mixing during exploitation phase.

FISHERY AND RESOURCE CHARACTERISTICS OF BOMBAY-DUCK (PF/RE/3)

Alexander Kurian and B. Manoj Kumar

The production trend of Bombay-duck for the past decade fluctuated from 0.47 lakh t in 1988 to 1.77 lakh t during 1995. During 1998 the production was 1.2 lakh t registering an increase of 17.3% over the last year.

The total landing during 1998 was estimated at 1,10,503 t with *dol*net effort of 6,09,212 hauls (catch per haul of 181 kg). There has been a reduction of catch and catch/haul from that of 1997 (1,12,566 t; 733 kg). Similarly, a reduction in effort from 7,67,683 hauls in 1997 was also observed.

However, the cpue increased from 146 kg (1997) to 181 kg (1998).

There has been slight reduction in the proportion of Bombay-duck in the total *dol*net landing (58 % in 1997 and 55 % in 1998). It is interesting to note that the catchability coefficient during 1997 was 3.8×10^{-7} and for 1998 the value was at around 3.77×10^{-7}, indicating the probability of capture remaining almost constant and further indicating a need for reduction in effort.

The trend in the fishery was positive for Maharashtra during 1998 when compared to that in 1997. Despite an increase in effort, there has been slight increase in total *dol*net catch (3,897 t) in 1997 and 4,283 t in 1998 against an estimated effort of 48,630 hauls in 1997 and 52,338 hauls in 1998. The cpue of the total *dol*net landings and that of Bombay-duck did not register any perceptible increase.

In Gujarat, the total *dol*net catch declined from 1,08,667 t in 1997 to 1,06,220 t in 1998 against estimated effort of 7,19,053 hauls in 1997 to 5,56,874 hauls in 1998 with a cpue of 151 kg and 191 kg respectively. The Bombay-duck landing also decreased from 62,174 t in 1997 to 57,390 t in 1998. However, the cpue increased from 86 kg in 1997 to 103 kg in 1998. At Nawabunder, Rajpara and Jafrabad its landings in 1998 were 13,006t (-8%), 23,209t (-6.5%) and 21,175t (-8.6%) respectively (comparison with the trend is given in brackets). Though the effort level has gone up by 4.6% at Nawabunder the c/haul was 61 kg against 70kg of last year. However, at Rajapara and Jafrabad the effort level which was low by 11% and 22% indicated a higher c/haul of 102kg (+4%) and 105kg (+17%) respectively.

Juvenile Bombay-duck ranked first as the most preferred food item followed by nonpenaeid prawns and golden anchovy. Studies on the breeding cycle indicated strong year classes entering the fishery. The continuous appearance of new recruits of 30mm and above in the catch indicates that the species breeds throughout the year. The peak breeding season is from November to March. In Maharashtra, males dominated the catch from December to May and females during the rest of the period. The proportion of the juveniles in the catch was low (35%) in Maharashtra compared to 56% in Nawabunder, 50.5% in Rajpara and 51.4% in Jafrabad in Gujarat. Further, the mean fish size was high (181.7 mm) in Maharashtra than that at Nawabunder (144 mm), Rajpara (150.8 mm) and Jafrabad (145.3 mm).

In Gujarat 30-314 mm and in Maharashtra 30-330 mm fishes were caught. The spawning ground in all probability lies north off Mumbai and off the Gulf off Cambay. The occurrence of juveniles (30 mm and above) in higher proportion (83%) at Rajpara was noticed during April. At Nawabunder, a centre lying towards west of Rajpara the juveniles formed only 60% during March and April and at Jafrabad, a centre lying east of Rajpara, the juveniles occurred in good numbers (70%) only during June. Probably, the juveniles, from the spawning ground are carried to south towards centres in Maharashtra with a peak occurrence during June.

FISHERY AND RESOURCE CHARACTERISTICS OF RIBBONFISHES (PF/RE/4)

P.N.Radhakrishnan Nair, B.Manoj Kumar, M.Zaffar Khan, U.Ganga, C.Muthiah, R.Thiagarajan and E.M.Abdussamad

The development of an export trade to China gave necessary fillip to exploit the ribbonfish resource which ultimately resulted in a peak production of 1.7 lakh t in 1997. But the production came down to 1.1 lakh t in 1998 as a result of less exploitation especially, along the NW and NE coasts of India which are the most production zone, due to problems in the export of this commodity. During 1998 ribbonfishes constituted 8.3% of the total marine fish landings pooled for all the 9 observation centres viz., at Veraval, Mumbai, Karwar, Mangalore, Kochi, Vizhinjam, Madras, Kakinada and Visakhapatnam. The major gear used in their exploitation is the trawl net in which nearly 97% of the annual catch was landed. The composition of ribbonfishes in trawl net ranged from 0.7% at Karwar and Visakhapatnam to 15.5% at Cochin. It is also caught in gillnet, purseseine, boatseine and other indigenous gears in certain centres like Veraval, Madhwad, Mangalore, Kochi, Vizhinjam and Visakhapatnam. At Vizhinjam, ribbonfish are caught in boatseine and drift gillnet.

Compared to 1997, an increase in the effort of trawl unit was noticed in 1998 at Karwar (23%), Madras (58.3%), Kakinada (13.8%) and Visakhapatnam (51.1%). In other centres such as Veraval, Mumbai, Mangalore-Malpe, and Cochin the effort decreased by 28.8%, 12.7%, 15.3% and 5.1% respectively. In the case of gillnet the effort as well as catch decreased at Veraval, Madhwad and Cochin but at Vizhinjam the catch decreased by 39.5% while the effort increased by 39.9%.

State wise landings of Ribbonfishes during 1997 and 1998

The estimated ribbonfish landings by trawl ranged from 57t at Karwar to 9174t at Veraval along the west coast and from 147t at Visakhapatnam to 4664t at Kakinada along the east coast. At other centres the landings were 2164t at Mumbai, 2202t at Mangalore-Malpe, 2862t at Kochi and 2240t

at Madras. The estimated landings in gillnet at Veraval, Madhwad, Kochi and Vizhinjam were 30t, 29t, 6t and 32t respectively. A drastic decline in its catch was noticed in boatseine at Visakhapatnam. It landed 16t of ribbonfish compared to 210t in 1997. An improvement in the fishery could be noticed only at Madras and Kakinada where the effort, catch and catch rate increased, whereas at Cochin, though the catch increased, the effort declined. As a result the catch rate showed an increase of 164% than in 1997. Nearly 71% of the all India ribbionfish catch was obtained from the west coast and only 29% came from the east coast.

The C/E in trawl net ranged from 0.6kg at Visakhapatnam to 153kg at Cochin with 77.7kg at Mumbai, 2.2kg at Karwar, 37.9kg at Mangalore-Malpe and 41.7kg at Madras and 72.5kg at Kakinada. The catch rates in gillnet were 1kg at Veraval, 1.3kg at Madhwad, 0.8kg at Kochi and 0.4Kg at Vizhinjam. It was 9.3kg in boatseine at Visakhapatnam.

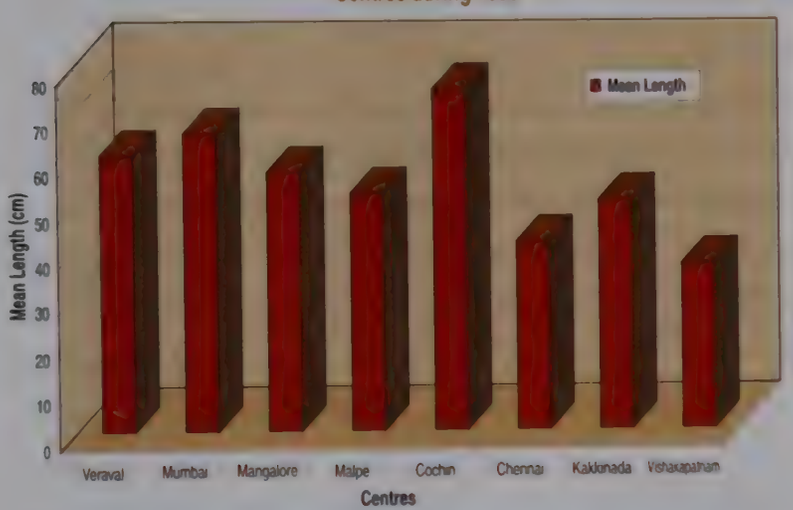
Along the west coast, the fishery existed almost throughout the year at Veraval, Mumbai, and Mangalore-Malpe. But at Cochin and Vizhinjam it was seasonal extending from May to December and July to September respectively. The peak landings were noticed in January-May (37.6%) and October-November (53.2%) at Veraval; January-April (37.6%) and September-December (59%) at Mumbai; January-February (63.9%) and April (26.9%) at Karwar; January-May (80.7%) and October-December (16.4%) at Mangalore-Malpe; August-October (99.3%) at Kochi; July (92.3%) at Vizhinjam; January-April (38.6%) and September-December (44.4%) at Madras; January-March (31%) and September-December (58.8%) at Kakinada; and June-December (95%) at Visakhapatnam. It could be noticed that the postmonsoon (September to December) and premonsoon (January-May) periods were the peak ribbonfish fishery seasons contributing 57.4% and 35.5% respectively, the rest (7.1%) was landed during the monsoon period (July-August).

Trichiurus lepturus was the dominant species in all the centres. From Kakinada and Visakhapatnam other species like *T. russelli*, *Lepturacanthus savala*, *L.gangeticus*, *Eupleurogrammus muticus* and *E.glossodon* were also reported and they together constituted 8.3% and 2% respectively. The minimum size of recruitment of *T.lepturus* in trawl was 10cm reported from Madras in September and from Kakinada in March. In other centres it was 20cm at Veraval (March), 30cm at Mumbai (March), 17cm at Karwar (March), 30cm at Mangalore-Malpe (January), 35cm at Kochi (October), and 18cm at Visakhapatnam (April & July). The recruitment size in gillnet was 44cm both at Veraval (June) and Madhwad (December). The smallest size caught in boatseine at Visakhapatnam was 18cm in July.

The largest size of *T.lepturus* caught in trawl was 126cm at Veraval. In gillnet and boatseine the target groups length were 106cm (Madhwad) and 110cm (Vizhinjam)

respectively. The major modes observed in trawl net were at 64cm at Veraval, 65cm at Mumbai, 46cm at Mangalore-Malpe, 82cm at Kochi, 30cm at Madras, 46cm at Kakinada and 28cm at Visakhapatnam. The annual mean length in trawl net ranged from 36.3cm (Visakhapatnam) to 74.8cm (Kochi). In gillnet it was 68.9cm at Veraval and 74.4cm at Madhwad. In boatseine the mean length was 41.1cm at Visakhapatnam and 54.9cm at Vizhinjam.

Annual Mean length distribution of *Trichiurus lepturus* in trawl net at different Centres during 1998



The exploitation of fish measuring less than 50cm was maximum at Visakhapatnam (91.6%) followed by Madras (69.9%). At Kakinada this size range contributed 47.7% and it was minimum at Kochi (0.9%). 50-100cm size groups dominated at Veraval (75.2%), Mumbai (92.9%), Mangalore-Malpe (63.9%), Kochi (98.9%) and Kakinada (50.54%). Fishes measuring above one meter were more at Kakinada (1.7%) and Veraval (1.3%); minimum at Mangalore-Malpe (0.02%) and totally absent at Madras and Visakhapatnam. In gillnet, at Veraval and Madhwad, 50-100cm sized fish dominated forming 97.8% and 91.9% and fishes larger than one meter formed 0.6% and 3.6% respectively. In boatseine at Visakhapatnam 70.3% was constituted by fish measuring less than 50cm., but at Vizhinjam 50-100cm size fish dominated forming 85%. In short, *T.lepturus* caught along the east coast are mostly under-sized, measuring less than 50cm, whereas it was between 50-100cm along the west coast.

The sex-ratio (M:F) among the pre-adults, reported from trawl catch at Mangalore-Malpe, Kochi, Kakinada and Visakhapatnam were 1:0.9, 1:1.2, 1:1.5 & 1:1.9 respectively. Among the adults females dominated at Veraval (63.2%), Mangalore-Malpe (56.1%), Madras (62.2%), Kakinada (53.9%) and Visakhapatnam (53.9%) and males at Cochin (52.7%). At Mumbai the M:F ratio was 1:1 among the adults. Spawning season was generally from January to June and November.

The major food items include *Decapterus* spp, *Nemipterus* spp, whitebaits, ribbonfishes, *Saurida*, *Priacanthus*, sardines, silverbellies, *Acetes*, prawns, *Squilla*, and small cephalopods.

FISHERY AND RESOURCE CHARACTERISTICS OF CARANGIDS (PF/RE/5)

H.Mohammed Kasim, B.Manoj Kumar, Prathibha Rohit, P.N.Radhakrishnan Nair and R. Thiagarajan

The annual catch of carangids increased from 24,560 t in 1969 to 137,908 t in 1997 with a peak production of 196,832 t in 1995. In 1998 the production was 1.47 lakh t. The major contribution towards the enhancement in catch is mainly from the small trawls and purseseines.

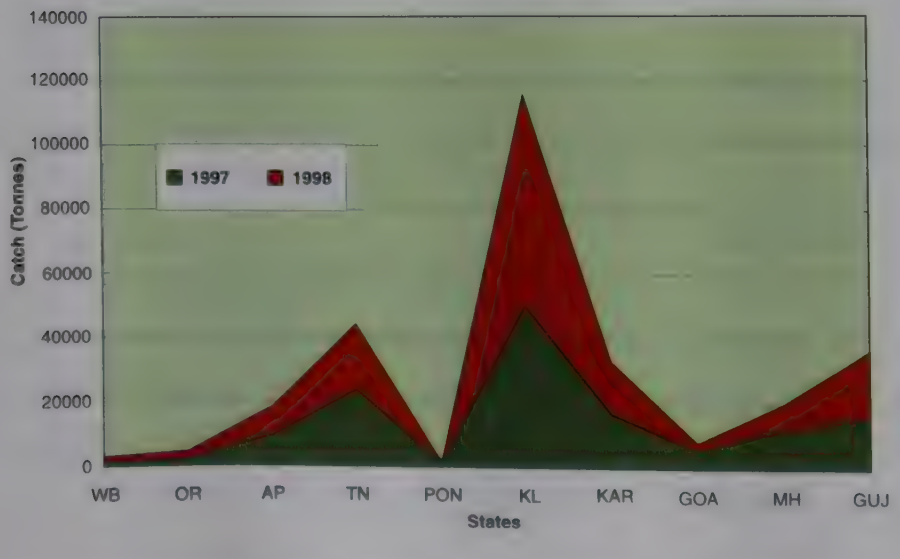
Fishery

Studies on the fishery and resource characteristics of carangids was carried out at Veraval, Mangalore, Kochi and Vizhinjam along the west coast, and at Tuticorin and Kakinada along the east coast. The estimated carangid catch during the current year was 1558 t at Veraval (-37.7%), 9487 t at Mangalore (+2.5%), 1262 t at Kochi (+26.4%), 4032 t at Tuticorin (-16.6%) and 3095 t at Kakinada. The trawls landed 79.4% of carangids at Veraval, 42.5% at Mangalore, 64.9% at Kochi, 82.9% at Tuticorin and 99.1% at Kakinada. The gillnets landed 20.6% at Veraval, 0.3% at Mangalore, 13.7% at Kochi, 6.8% at Tuticorin, 0.9% at Kakinada. The purseseine landed 57% at Mangalore and 10% at Kochi and ringseine landed 11.5% at Kochi. The hooks & lines landed 10.3% at Tuticorin. Trawl, purseseine, gillnet and ringseine are the major gears along the west coast whereas trawl, gillnet and hooks & lines are the chief gears employed along the east coast.

At Mangalore, the effort of purseseine and trawl declined by 16.3 and 15.4% respectively and that of gillnet increased by 46.7%. The trawl and gillnet effort declined by 23.4 and 3.6% respectively and that of purse seine and ringseine increased by 5.4 and 6% respectively at Kochi. At Tuticorin the effort input by trawl and hooks & lines declined by 18.4 and 50.9% respectively and that of *paruvalai* and *podivalai* increased by 87.3 and 3.9% respectively.

The c/e by both trawl and gillnet declined by 19 and 7.2% respectively at Veraval. The catch rate by purseseine and gillnet increased by 132.5 and 4.3%

Landings of Carangids in maritime states during 1997 and 1998



respectively and that of trawl declined by 26% at Mangalore. At Kochi the catch rate by purseseine increased by 35.5% followed by trawl 43.7%, gillnet 48.7% and ringseine 204%. The catch rate of *paruvalai* and trawl declined by 39.3 and 13% respectively and that of podivalai and hooks & lines increased by 37.5 and 24.5%.

Several species supported the carangid fishery and among them *M. cordyla* was the dominant species in both trawl and gillnet landings at Veraval; in trawl, purse seine and gillnet catches at Mangalore, in purseseine and gillnet at Kochi; in *podivalai* at Tuticorin and in trawl and gillnet at Kakinada. *Decapterus russelli* and *D. macrosoma* were the dominant species in purseseine and trawl at Mangalore and Kochi; in trawl alone at Kakinada. *S. crumenophthalmus* was dominant in trawl landings at Kochi and Tuticorin. *Caranx kalla* was the dominant species in purseseine and trawl landings at Mangalore. *C. carangus* was dominant in *podivalai*, *S. leptolepis* in trawl catches and *C. sexfasciatus* in gillnet catch at Tuticorin. It is concluded that *M. cordyla* occurred in all the centres, *Decapterus* spp at Mangalore, Kochi and Kakinada, *Caranx* spp. at Mangalore and Tuticorin.

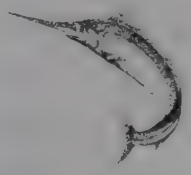
Biology

The size of *M. cordyla* varied from 190 to 399 mm in trawl and 170-479 mm in gillnet with multimodes at Veraval; it varied from 130-385 mm with dominant modes at 140 & 255 mm in purseseine; 85-350 mm in trawl with modes at 105,165 and 280 mm and in gillnet from 165-385 mm with modes at 185 and 335 mm at Mangalore; it ranged from 170-365 mm in trawl with mean length at 258 mm and from 170-335 mm in gillnet with dominant modes at 200, 210 and 225 mm at Kochi, it varied from 50-269 mm in trawl and 110-599 mm in gillnet with multimodes at Kakinada. The size range of *D. russelli* varied from 70-210 mm in purse seine with modes at 90 & 145 mm; 60-200mm in trawl catch with modes at 80 & 165 mm at Mangalore. At Kochi the size varied from 125-255 mm with mean length at 178 mm and at Kakinada it varied from 60-189 mm with multimodes. The size of *D. macrosoma* varied from 85-130 mm with modes at 100 & 120 mm in purse seine, in trawl from 80-230 mm with modes at 105 & 185 mm at Mangalore, it varied from 135-215 mm with modes at 175 and 195 mm and it ranged from 75-214 mm with dominant modes at 90,135 and 160 mm in trawl landings at Kakinada. At Mangalore, the size of *C. kalla* varied from 75-160 mm in trawl with modes at 90,100,115 and 130 mm and from 95-155 mm in purse seine with modes at 110 and 150 mm. The size of *S. crumenophthalmus* ranged from 115-260 mm in trawl catches with dominant modes at 170 and 190 mm and in gillnet landings from 155-250 mm with dominant modes at 165,215 and 230 mm and that of *Alepes djedaba* varied from 210-390 mm with dominant mode at 300 mm at Kochi. The size of *Caranx leptolepis* varied from 60-184 mm with dominant mode at 115 mm and that of *C. sexfasciatus* ranged from 40-128 cm with dominant modes at 74 and 84 cm at Tuticorin.

Actively fed full stomached *M. cordyla* were dominant both in trawl and gillnet landings and female were dominant. Specimens with gonads in III and IV stages were dominant in the landings of both the gears at Veraval. At Mangalore also the females with developing gonads of this species were dominant. Similar observation has been reported at Kochi for this species and both the sexes occurred at equal proportion.

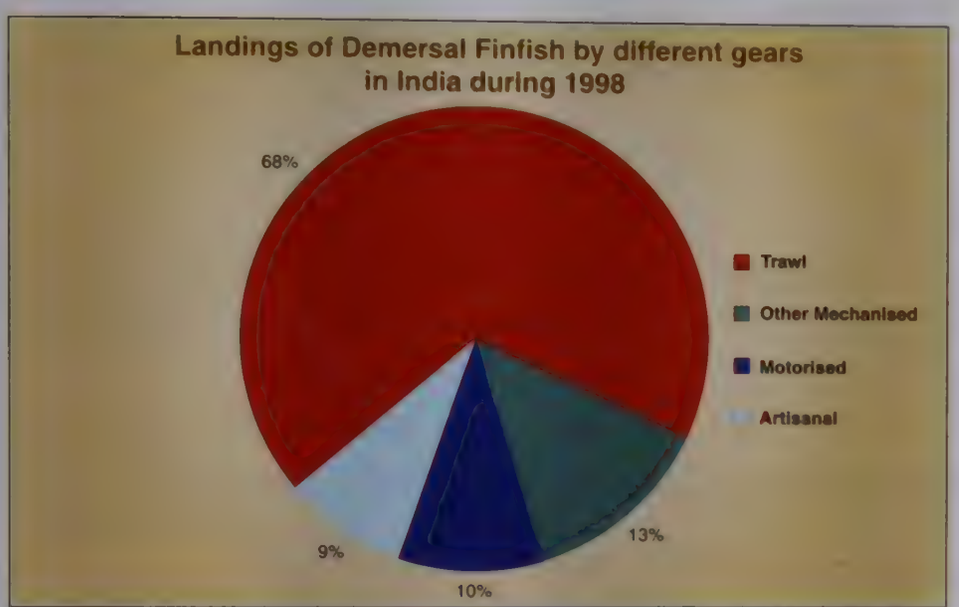
In both *D. russelli* and *D. macrosoma* the adults occurred more and males were dominant. Females with developing ovary were dominant followed by the spent specimens at Mangalore. Whereas at Kochi, the males were marginally dominant and more gravid females occurred followed by partially spent specimens among *D. russelli* and among *D. macrosoma*, the females occurred more and females with developing gonads were dominant. In both the species empty stomached specimen were dominant. Similarly at Kakinada also the males were dominant among *D. dayi* and females were dominant among *D. macrosoma*. In both the species the females with developing gonads were dominant.

At Mangalore, the adult *C. kalla* occurred more and the females were dominant with developing ovary in trawl landings and with gravid ovary in purseseine landings. At Kochi, preadults and immature *S. crumenophthalmus* occurred more and the females were dominant with developing ovary in trawl landings.

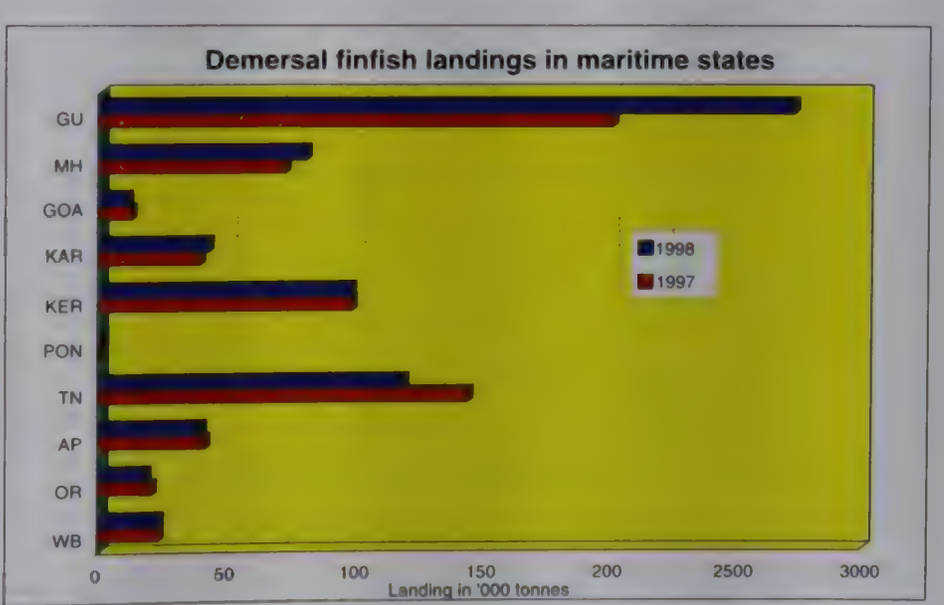


III. DEMERSAL FISHERIES DIVISION

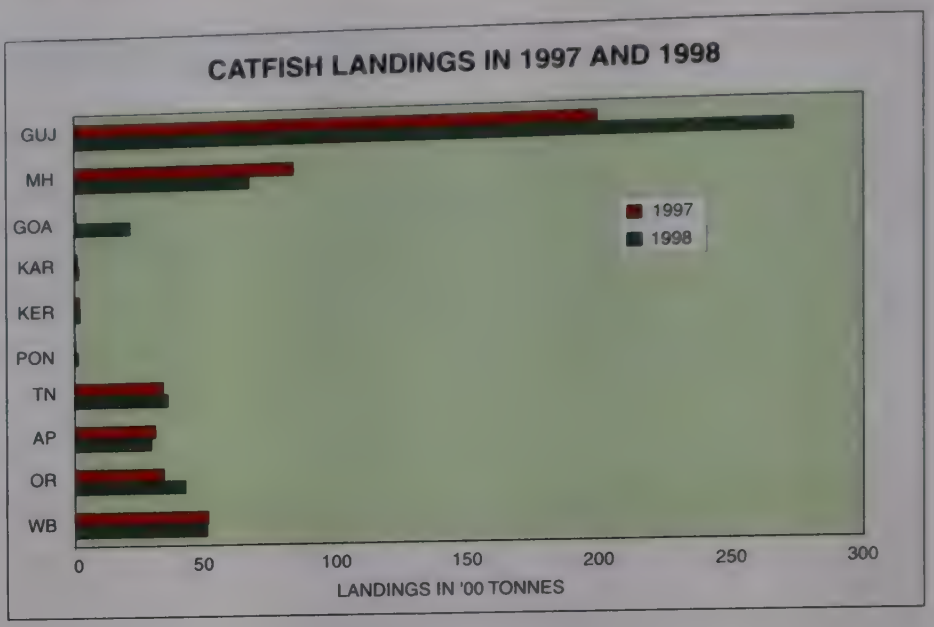
The total demersal finfish landing in India during the year, was estimated at 0.7 million t which formed 26% of the total marine fish production in the country. Of this, 68.1% was taken by trawl, 13.2% by other mechanised units, 10.2% by motorised units and 8.5% by artisanal units. Highest quantity, forming 38.7% of the demersal finfish catch in the country, was obtained from Gujarat, followed by Tamilnadu (16.8%), Kerala (13.9%), Maharashtra (11.4%), Karnataka (6%), Andhra Pradesh (5.6%), West Bengal (3.3%), Orissa (2.6%), Goa (1.5%) and Pondicherry (0.2%). The demersal finfish landings in the country increased by 8% over those of the previous year. This increase is mainly brought out by about 47% increase in the landings along the northwest coast though there was considerable decline in the landings along the east coast. This, further, is due to the substantial increase, along the Gujarat coast, in the landings of sharks (48%), skates (125%), catfish (37%), lizard fish (82%), threadfin breams (37%), and croakers (40%).



The fishery and biological characteristics of major exploited demersal finfish stocks were monitored from all along the Indian



coast and collection and analysis of data on dominant species of all major groups was continued during the year.



In the area of finfish mariculture, the division achieved the breakthrough in developing the broodstock from fingerlings, sex reversal, maturation and spawning of the grouper (*Epinephelus tauvina*) in onshore, fully controlled captive conditions, at the facility developed at the fisheries harbour at Cochin.

The details of the research work carried out and achievements during the year under report are furnished below.

INVESTIGATIONS ON THE RESOURCE CHARACTERISTICS OF ELASMOBRANCHS (DF/RE/1)

S.G.Raje, P. Livingston, G. Mohanraj, K.K.Joshi and Rekha J. Nair

This project was implemented at Chennai, Tuticorin and Mandapam on the east coast, Mumbai and Cochin along the west coast. The total estimated catch of elasmobranchs from all the Centres was 7840 t. The landing at Chennai was the highest (32%) of all the centres. The highest CPUE was recorded at Mumbai in trawl (81 kg), at Chennai in gillnet (67 kg) and in hook and line at Tuticorin (17 kg). Rays constituted 64% in total elasmobranch catch from all the centres. In the trawl catch, sharks constituted 78% and Rays 100% at Mumbai and Mandapam respectively.

MUMBAI

The estimated catch of elasmboranchs in the trawl net at New Ferry Wharf during 1998 was 2250t as against 2507t during the previous year showing a decrease of 10.2%. The contribution of elasmobranchs to the total fish catch was 4.9% and the CPUE 81.0 kg.

The catch of elasmobranchs in gillnet at Satpati was 148 t with CPUE 25.5 kg.

The estimated catch in *Dol* net at Versova was 7872 kg and CPUE 2 kg.

Sharks were the dominant group in Trawl, Gill and *Dol* nets. *Scoliodon laticaudus* (72%),

Estimated gearwise landing (t) of Elasmobranchs at different centres in 1998 (CPUE in kg in parentheses)

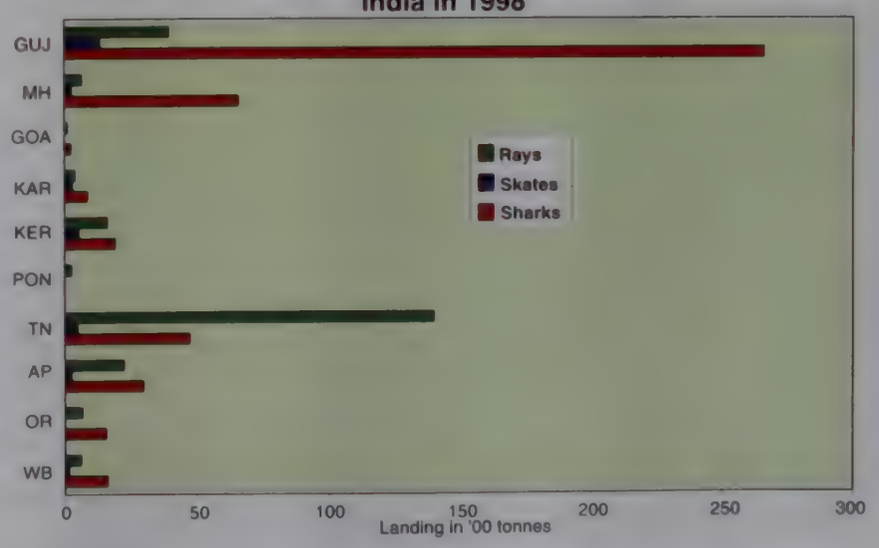
Gear	Mumbai	Cochin	Mandapam	Madras	Tuticorin	Total
Trawl	2250 (80.8)	185 (9.5)	933 (13.1)	2224 (41.4)	1403 (43.0)	6995
Drift gill net	148 (25.5)	166 (35.5)	-	244 (67.2)	- -	558 -
Hook & line	-	-	-	-	278 (16.9)	278
Dol net	8 (1.6)	-	-	-	-	8
Total	2406	351	933	2468	1681	7839
% in the total of all centres	30.7	4.5	11.9	31.5	21.4	

Dasyatis zugie (49%) and *Rhynobatus djiddensis* (97%) were the most dominant species in their respective groups.

The length range of *S. laticaudus* in males was 200-560 mm and 160-620 mm in females. In *D.imbricatus*, the same was 130-290 mm and 140-360 mm respectively.

The male:female ratio of *S. laticaudus* and *D.imbricatus* was 1:1.38 and 1:1.59 respectively. Pregnant females of *S.laticaudus* were observed during February to May and July to October and in *D.imbricatus* during April and August to October. The length range of embryos in *S.laticaudus* was 3-11cm and in *D.imbricatus* 1-2 cm. About 47% of guts in *S.laticaudus* and 60% in *D.imbricatus* were empty. Dominant food items observed in *S.laticaudus* were *Coilia dussumieri, Harpodon nehereus,* sciaenids and *Loligo* sp. *D.imbricatus* was found to feed on *Acetes* sp., *N. tenuipes,*

Landings of sharks, skates and rays in maritime states of India in 1998



Estimated landing (t) of Sharks, Rays and Skates at different centres in 1998

Centre	Sharks	Rays	Skates
Mumbai	1867	416	123
Cochin	128	199	24
Mandapam	-	933	-
Madras	323	2100	45
Tuticorin	211	1396	73
Total	2529	5044	265

Loligo sp. and *Sepia* sp.

In the case of rays: *Dasyatis zugie, D.bleekeri, D.uarnak, D.sephen, T.walga* and *G.micrura,* females were dominant in *D.bleekeri, D.uarnak* and *G.micrura.* The male to female ratio in *R.djiddensis, R.granulatus* and *R.halvai* was 2:1.7; 1:0.5 and 1:3.33 respectively.

COCHIN

The total estimated catch of elasmobranchs at Cochin Fisheries Harbour was 351 t. Trawlers contributed 185 t with CPUE of 85 kg and gillnetters 166 t with CPUE of 35.5 kg. The contribution of this group in trawl net and gillnet was 1.0% and 8.9% respectively. The dominant species in the catches of both the gears in shark, rays and skates were *C.melanopterus, D.uarnak* and *R. djiddensis* respectively.

The size range of *C .melanopterus* and *R.acutus* in drift gillnet was 30-120 cm (mode at 70 cm) and 40-120 cm (mode at 80 cm) respectively.

TUTICORIN

The estimated total catch of elasmobranchs at this centre was 1680 t. Of this, fish trawl contributed 1403 t (85.5%) and hook and line 277 t (16.5%). The CPUE was 42.9 kg in trawl net and 16.9 kg in hook and line. The size range of *Amphotistus kuhli* and *D. imbricatus* was 15-49 cm and 16-36 cm respectively.

In hook and line, *D.bleekeri* and *Carcharhinus bleekeri* were dominant among rays and sharks respectively. *D.bleekeri, C.bleekeri* and *Rhynobatus granulatus* were the dominant species in their respective groups in trawl catch.

MADRAS

The total estimated catch of elasmobranchs in trawl net and gillnet at Kasimedu landing centre was 2468 t. The landing at this centre was reported to have increased two-fold, compared to the previous year. About 90% of catch of elasmobranchs was landed by trawlers and 10% by gillnetters. The CPUE was 41.4 kg for trawlers and 67.2 kg for gillnets. The size range of *D.jenkinsi* was 10-109 cm; males were dominant in this species.

MANDAPAM

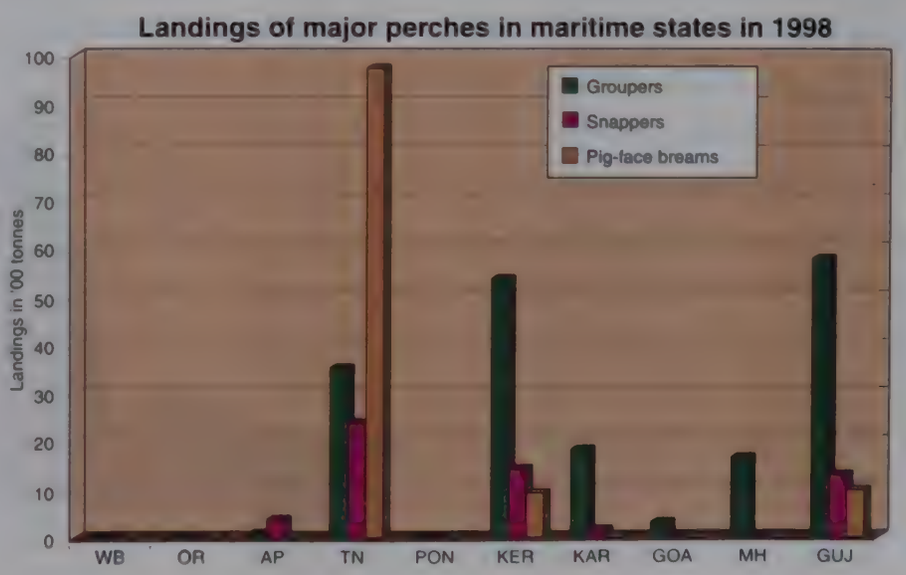
The total estimated catch of elasmobranchs in trawls landed at Rameswaram and Pamban was 933 t with CPUE of 13 kg. The contribution of elasmobranchs to total fish catch from Rameswaram in trawl net was 886 t (CPUE 13.1 kg) and at Pamban 46 t (CPUE 12.3 kg). Biological data were collected in *D.sephen, D.uarnak, D.bleekeri, R.javanica, G.micrura, A.narinari, A. slagettus, C. indicus* and *C .melanopterus.*

MONITORING THE RESOURCE CHARACTERISTICS OF GROUPERS, SNAPPERS AND PIGFACE BREAMS (DF/RE/2)

Grace Mathew,S.K.Chakraborthy, P. Livingston, S. Krishna Pillai and P. Nammalwar

During the year under report, an estimated 6779 t of major perches were landed from the four centres: Cochin, Vizhinjam,Tuticorin and Chennai in the southern region and Mumbai on the northwest. The major gears in the exploitation of the major perches were trawl, hooks and lines and drift gillnets using mechanised or motorised units. As observed in the previous years, maximum catches of perches were recorded from Tuticorin in the Gulf of Mannar region; a total of 5055 t of perches forming 74.5% was landed at this centre. Kochi on the southwest contributed 1089 t forming 16% followed by Vizhinjam 308 t (4.5%) and Mumbai 322 t (4.7%). At Tuticorin, the peak landings were obtained during May-August while at Cochin maximum landings occurred during December, January and March; fairly good landings were recorded in August also. In Mumbai, fairly high catches were recorded in January, February and May. At Vizhinjam peak catches were recorded during December and fairly high catches were observed during January-March period.

At Tuticorin, all the groups of major perches occurred in the fishery in almost



equal quantities, the groupers being the dominant group. At Vizhinjam, the snappers were predominant, followed by groupers ; at Cochin, the major group was grouper. *Epinephelus diacanthus* formed the major perch fishery at Mumbai. It was also observed that along the west coast, *Epinephelus diacanathus* and *Pristipomoides* spp were the dominant species. On the east coast, *Lethrinus nebulosus, Lutjanus rivulatus,* and *Epinephelus tauvina* were the most dominant species.

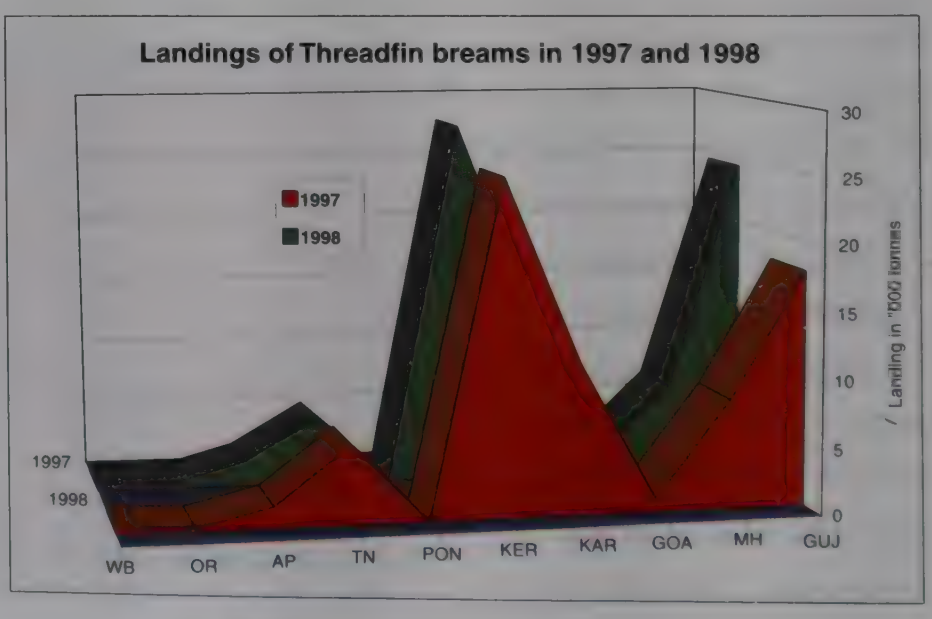
DEVELOPMENT OF MANAGEMENT STRATEGIES FOR SUSTAINABLE FISHERY OF THREADFIN BREAMS AND SILVERBELLIES (DF/RE/4)

V. Sriramachandra Murty, P.U. Zacharia, K.K. Joshi, E.Vivekanandan, Rekha J .Nair, U. Rajkumar and Sobha J. Kizhakudan

THREADFIN BREAMS

At Veraval about 2600 t of threadfin breams were landed by trawlers; maximum catch accounting for 55% of the total landings in the year, was obtained during February-April. When compared to the previous year, the catches declined by 35% along with 30% decline in the effort. The major reason for the decline in the landing at this centre appears to be due to over 90% decline in the landings in January 1998 when compared to January 1997, while the effort was more or less same in this month during both the years. *N. japonicus* was the most dominant species followed by *N. mesoprion*. These two species together accounted over 80% of the threadfin bream landing.

At Mangalore an estimated 12000 t of these fishes were landed forming 22% of the total trawl landing. September-November accounted for 60% of the threadfin breams landed during the year; *Nemipterus mesoprion* was the most dominant species during these three months contributing to about 40% of total nemipterid landing during the year. Only two species *N. japonicus* and *N. mesoprion* contributed to the fishery at this centre with



the former being the most dominant from January to June. When compared to the previous year, the landings at this centre registered an increase of 22%.

At Cochin, an estimated 1545 t of nemipterids were landed forming 13% of the total trawl landings. Peak landings were obtained during June and August, the landings during these months together accounted for 65% of total *Nemipterus* landings during the year. *N. mesoprion* was the most dominant species in all the months except November and December when *N. japonicus* was dominant.

At Madras an estimated 2400 t of threadfin breams were landed forming about 7% of total trawl landings. Peak landings were obtained during August-October period; the landing increased by 15% over the previous year. Of the 4 species that contributed to the fishery, *N. japonicus* was dominant forming about 40% of the threadifn bream landing.

At Visakhapatnam, the threadfin bream landings were estimated at 542 t of which 75% was taken by small trawlers and the rest by *Sona* boats. There was a marginal increase in the catch of this group over that of the previous year. Peak landings were obtained during March-May. Of the 5 species in the fishery, *N. mesoprion* was the most dominant, contributing to 66% of *Nemipterus* catch by small trawl and 45% by *Sona* boat followed by *N. japonicus* and others.

At Kakinada, an estimated 363 t of nemipterids were landed by the trawlers of different categories with *Sona* boats contributing 60% and the rest by small trawlers. When compared to the previous year, the landings declined by 9%. Peak landings were obtained during January and August.

The length range in the catch of *N. japonicus* at Veraval was 100-329 mm with the bulk of the catch belonging to the length range 120-250 mm; the length range was 100-290 mm at Mangalore; 80-279 mm at Madras; 110-240 mm at Visakhapatnam and 35-295 mm at Kakinada. In *N. mesoprion,* the length range was 100-250 mm at Mangalore; 40-350 mm at Cochin and 85-195 mm at Kakinada. Gravid individuals of *N. japonicus* occurred during January-March and September-November, but large numbers occurred in September-November in the Mangalore region. In the case of *N. mesoprion,* such fishes occurred almost throughout the year but in large quantities during April-September and November at Mnagalore. At Madras, *N. japonicus* with ripe gonads occurred during January and November.

SILVER BELLIES

At Veraval about 488 t of silverbellies were landed by trawlers with maximum catch during September. The catch showed a decline of 26% over the previous year.

At Mangalore, an estimated 1132 t of these fishes were landed forming 1.8% of the trawl landings. January-April period accounted for 53% of the silver belly landing during the year. *Secutor insidiator* was the most dominant species during the year contributing to about 66% of total silverbelly landing; *Leiognathus*

bindus and *L. splendens* formed 23% and 11% of silverbelly landings respectively.

At Cochin, an estimated 9.4 t of silverbellies were landed by trawlers. Peak landings were obtained during January-March, the landing during these months accounted for 68% of total silverbelly landings in the year. *L. splendens* was the most dominant species, it formed 50% of total silverbelly landing followed by *S. insidiator* (24%).

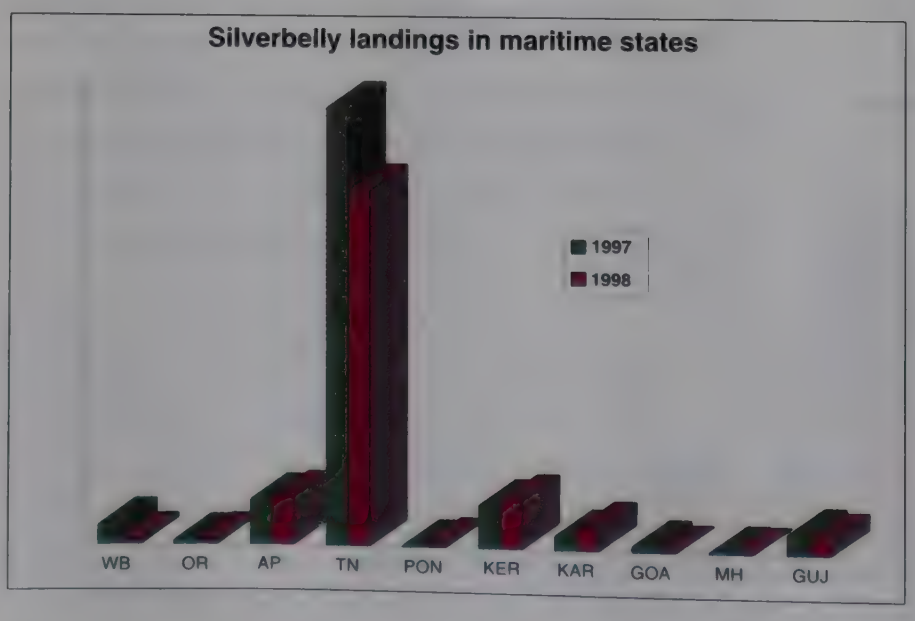
At Rameswaram, the trawlers landed an estimated 11898 t during this year. The silverbelly landing formed 41% of the total landing at this centre. When compared to the previous year, the landings registered a decrease of 18 %. *L. brevirostris* was the most dominant species followed by *L. jonesi*. These two species accounted for over 90% of the total landings.

At Pamban and Mandapam, the landings were estimated as 352 and 720 t respectively. *L. dussumieri* was the most dominant species forming 54% of silverbelly landing.

At Madars, the trawlers landed an estimated 4340 t of silverbellies, which formed 11.9% of the total trawl landings. The catch showed an increase of 35% when compared to the previous year. *L .bindus*(31%) and *S. insidiator*(26%) were dominant in the landings.

An estimated 297 t of silverbellies were landed at Visakhapatnam, of which 63% was taken by small trawlers and the rest by *Sona* boats. There was a marginal increase in the catch of this group when compared to the previous year. Peak landings occurred during May -June. Of the 8 species in the fishery by small trawlers, *L. bindus* was the most dominant, contributing to 40% of the silverbelly catch followed by *S. insidiator* (18%) and *G. minuta* (14%).

At Kakinada, the trawlers landed an estimated 1141 t of silverbellies. Peak landings were obtained during December-January. The catch showed an increase of 23% when compared to the previous year. The catch consisted of 10 species of which *L. bindus* was dominant (27%), followed by *S. insidiator* (21%), *L. splendens* (17%) and *G. minuta* (11%).



The length range in the catch of *L. bindus* at Mangalore was 75-105 mm; at Madras 40-120 mm; at Kakinada 22-127 mm. In *L. dussumieri*, the length range was 55-130 mm at Pamban. At Rameswaram the length range of *L .brevirostris* was 40-135 mm and *L. jonesi* was in 50-140 mm. At Cochin, *L. splendens* was in the length range of 35-125 mm. In *S. insidiator* the length range was 65-105 mm at Mangalore; 22-115 mm at Cochin and 65-114 mm at Visakhapatnam.

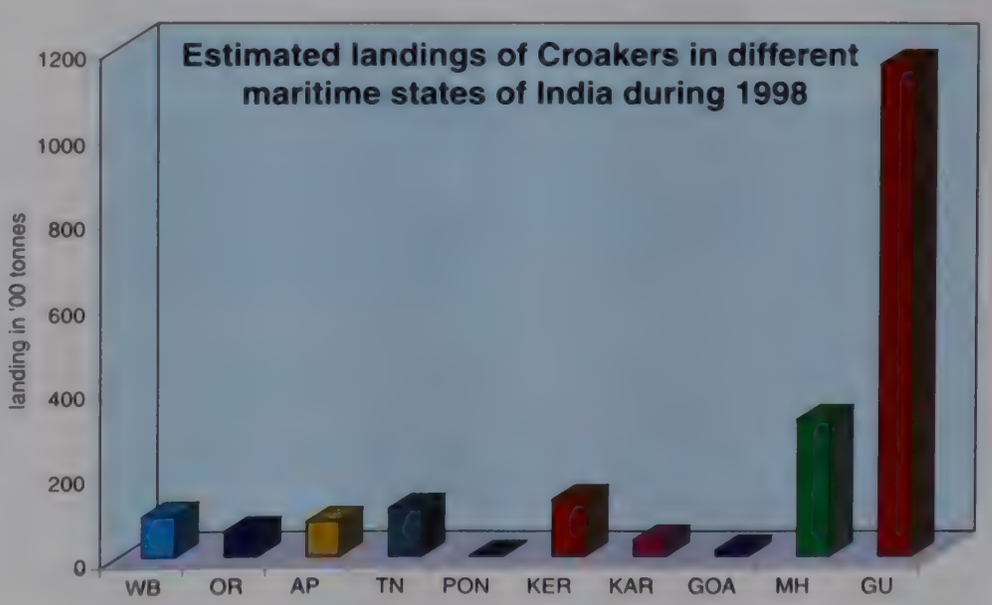
DEVELOPMENT OF MANAGEMENT STRATEGIES FOR JUDICIOUS EXPLOITATION OF SCIAENIDS (DF/RE/5)

G. Mohanraj, S.K. Chakraborthy, M. Feroz Khan, S. Sivakami, P. Livingston, Rekha J. Nair, U. Rajkumar and Shobha J. Kizhakudan

The estimated total catch of sciaenids at the ten observation centres was 23273 t during 1998. The contribution of trawlers was 95.3% and the rest was shared by *dol* nets (3.3%), gillnets (1.1%) and shore seines (0.2%). At Mumbai, Calicut, Cochin, Tuticorin, Mandapam, Madras, Kakinada and Visakhapatnam, the catches were exclusively taken by the trawlers. At Veraval, in addition to the trawl (90.6%), gillnets and *dol* nets contributed to the catch. At Karwar, 92.7% of the catch was from the trawlers and the rest from the shore-seines.

The catch at different centres ranged between 95 and 9018 tonnes. The highest catch of sciaenids was recorded at Veraval followed by Mumbai. The lowest catch was reported from Cochin. The highest CPUE was recorded at Mumbai (227.9 kg) and the lowest at Cochin (4.1 kg).

At Kakinada, an estimated 197 tonnes of



Biological data on dominant sciaenid species from different centres along the Indian coast

Centre	Species	Length range (mm)	Remarks
Veraval	*Otolithus cuvieri*	80-370	—
	Johnius glaucus	60-310	—
	Protonibea diacanthus	200-1270	—
Mumbai	*Johnius vogleri*	105-325	—
	J. macrorhynus	105-305	—
	O. cuvieri	115-345	—
	J. sina	105-225	—
Karwar	*O. cuvieri*	80-279	—
Cochin	*J. sina*	70-190	Ripe fishes occurred during January-June
	O. ruber	100-370	Ripe individuals occurred in December and February-April
Tuticorin	*O. ruber*	110-380	
	J. maculatus	100-290	
Mandapam	*P. macrophthalmus*	70-210	
	N. maculata	110-220	
Madras	*O. ruber*	20-290	Dominant mode at160 mm)
	K. axillaris	110-150	(Dominant mode at140 mm) gravid adults occurred during April
Kakinada	*N. maculata*	55-265	(Dominant mode at 145mm)
Visakhapatnam	*J. carutta*	115-215	

sciaenid juveniles with 40-183 mm size range forming 12.5% of the total sciaenid catch was taken during the year. Maximum quantity of the juveniles was recorded during January.

When compared to the previous year, slight decline in the catch at Kakinada (3.2%) and Veraval (25%) and sharp decline at Karwar (65%) and Cochin (68%) was noticed. Marginal increase at Navabander (10%), Calicut (12%) and substantial increase at Mumbai (35.1%) and Visakhapatnam (35% for small trawlers and 55% for *Sona* boats) was recorded.

Centrewise production of Sciaenids during 1998

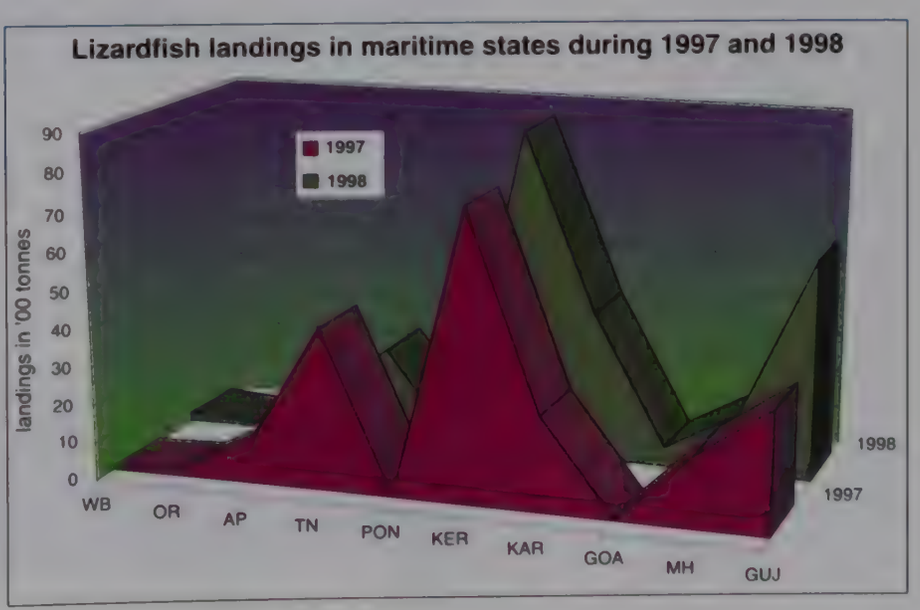
Centre	Estimated Catch (t)	CPUE (kg)
Veraval	9018 (Trawl net)	127
	234 (Gill net)	8
	696 (*Dol* net)	24
Mumbai	6369 (Trawl net)	228
Karwar	597 (Trawl net)	20
	46 (Shore seine)	7
Calicut	652 (Trawl net)	11
Cochin	95 (Trawl net)	4
Tuticorin	573 (Trawl net)	18
Mandapam	540 (Trawl net)	5
Madras	2383 (Trawl net)	44
Kakinada	1579 (Trawl net)	25
Visakhapatnam	282 (Small trawlers)	24
	209 (*Sona* boats)	66
Total	23273	

RESOURCE CHARACTERISTICS AND BIOLOGY OF LIZARDFISHES,THREADFINS, POMFRETS AND BULL'S EYE (DF/RE/6)

S. Sivakami, E. Vivekanandan, S.G. Raje, M. Feroz Khan, U. Rajkumar and Shobha J. Kizhakudan

LIZARD FISHES

The fishery increased by 294% when compared to 1997 at Puthiappa even with a decrease in effort by 10312 units. A similar trend was observed at Beypore also. The catch decreased this year by 43.4% at Mumbai (NFW), Madras (46.2%) and Visakhapatnam. At



Cochin however, there was an increase in the catch by 4.4%.

At all the centres except Madras and Visakhapatnam, the effort decreased this year. From Veraval, it is reported that the slump in economy in the Southeast and, China resulted in reduction in total effort and fish landings.

The landings were more during April and December at Veraval, May at Mangrol, January to May at Mumbai, March-April and August-September at Calicut, June, August-October and December at Cochin and January to March at Madras and Visakhapatnam. At Cochin, the catch rates were high during August to October.

Saurida tumbil was dominant at Calicut, Veraval, Mangrol and Mumbai. *S. undosquamis* formed 31% at Cochin, 100% at Madras and 64.5% and 52% in small trawlers and *Sona* units respectvely at Visakhapatnam.

At Veraval, *S. tumbil* was in the length range of 165-495mm with the fishes in the 275-395 mm length forming 78% of the catch of the species. At Mumbai, fishes ranging from 65 mm to 185 mm formed 18.5%, while fishes in the 195-335 mm group formed 75% of the total. At Cochn, *S. tumbil* was in the length range 225-465 mm with fishes in 255 - 385 mm groups forming 91% of the catch of the species; the size distribution shows that the fishes above 300 mm formed about 59% and 51% of the total catch of the species during August – September.

In *S. undosquamis* off Mumbai, 125-225 mm groups formed 87.2% of the species catch and 185-265 mm group formed 73.5% at Cochin. At Madras, the size groups 125-205 mm formed 90% of the total fish landed in the length range 95-315 mm.

THREADFINS

The catch declined by 62.7% at Veraval in trawl and 24% in gillnet, over that of the previous year. At Mangrol, the decline was by 55.3% in trawl. At Dhamlej, in gill net, the catch declined by 45.2%. At Mumbai, in trawl, the catch declined by 49.2%. In all the centres, the effort was on the declining side this year.

At Veraval, the catch rate in trawl was higher during January/February and November/December months. In gillnet, maximum CPUE of 6.48 kg was obtained during January 98. At Mangrol, the higher CPUE was during May. At Dhamlej in gill net, also higher catch rate was during January; while at Mumbai, it was during January to April and December.

Polynemus indicus was the dominant species at Veraval in trawl (47.7%), in gill net (30.2%) and at Mumbai in trawl (56%). The other species represented were *Eleutheronema tetradactylum* (9-38.5%), *P. heptadactylum* (7.2%), and *P. sextarius* (24.6%).

The length range of *Polynemus indicus* in trawl at Veraval was 170-770 mm and 310-1090 mm in gillnet at Dhamlej. Off Mumbai, *P. heptadactylus* (65-275 mm) caught in trawl

had size groups 85-135 mm forming 91.2% of the total species catch.

POMFRETS

Pomfret landing also showed declining trend at Veraval (44.6 %) and Mangrol in trawl (22.5%),Mumbai - NFW (18%), Versova (*dol* net - 64.5%), Puthiappa (89%), Beypore (76.5%),Cochin - trawl (96%), Madras (15.4%) and Visakhapatnam -*Sona* boat (14%). The catch showed an increasing trend at Satpathi (Mumbai) in gillnet (67%),at Cochin in gill nets (10 times) and Visakhapatnam - trawl (58.5%).

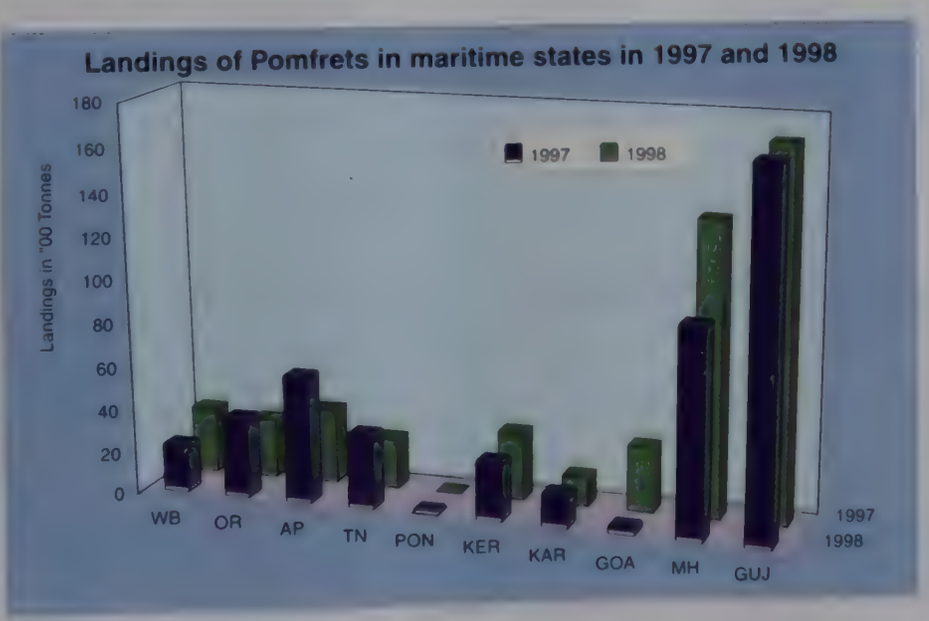
Pomfrets were caught more during the first and last quarter at Veraval, Mangrol and Mumbai. From Satpathi in gill nets, higher catch rates of 245.7 kg to 724.4 kg were obtained during August-October period. Likewise, at Visakhapatnam in *Sona* boat, catch rate (99 kg) was obtained during February. *Pampus argenteus* was dominant at Mumbai and *Formio niger* at Calicut.

P. argenteus observed off Mumbai in trawl (45-295 mm) had the size groups 65-115 mm forming 61% while those within the size groups 175-215 mm forming 22.5%. At Satpathi in gillnet (85-335 mm), size groups 135-235 mm formed 84.5% of the total catch of the species.

The food of *P.argenteus* (50 - 300 mm) off Mumbai was observed to be *Acetes* sp, medusae, and prawns.

BULL'S EYE

The fishery declined over the previous year at Veraval (52.5%), Mangrol (13.3%), Mumbai (Sasoon Dock) (71%), Puthiappa (88.7%), Beypore (82%) and Cochin (46.7%) and increased at Visakhapatnam byover 100% in the *Sona* type trawlers. *Priacanthus hamrur* was the only speies at all the centres.



The length range of this species at Mumbai was 95-305 mm with 155-195 mm group forming 83%, and the length range at Cochin was 155-335 mm with 185-245 mm groups forming 77.5% of the total catch. At Cochin, *P.hamrur* had the ovaries in stage VI during January - April.

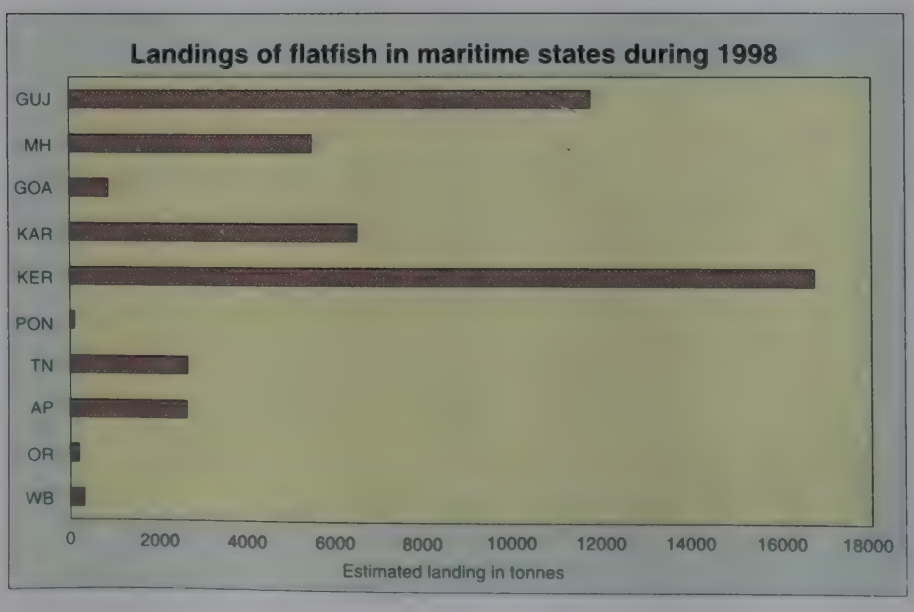
BIOLOGY AND FISHERY OF FLATFISHES, GOATFISHES AND WHITEFISH (DF/RE/7)

E. Vivekanandan, P.U. Zacharia, M. Ferozkhan, S. Krishna Pillai, K.K. Joshi, U. Rajkumar and Rekha J. Nair

FLATFISHES

The flatfish fishery dominated along the southwest coast, especially along the north Kerala – south Karnataka coast. The landing in Mangalore - Malpe was 2333 tonnes during 1998 and formed 3.4% of the total trawl landings. Along the south Kerala coast and the Gulf of Mannar, the landings contributed 0.2 to 1.5% of the total landings.

The flatfishes have a distinct species distribution pattern. Whereas *Cynoglossus macrostomus* dominated the landings along the north Kerala-south Karnataka coast (90% of the flatfish landings), *C. bilineatus* (93.5%) and *C. macrolepidotus* (46 to 74%) dominated in the south Kerala coast and the Gulf of Mannar.



Along the southwest coast, the length range of *C. macrostomus* was 50-169 mm and the modal length was 110-119 mm.

GOATFISHES

The goatfishes were dominant along the east coast, especially between Mandapam and Visakhapatnam, where they formed 3.9 to 6.0% of the total trawl landings. During 1998, the landing was maximum (1654 t) in Madras.

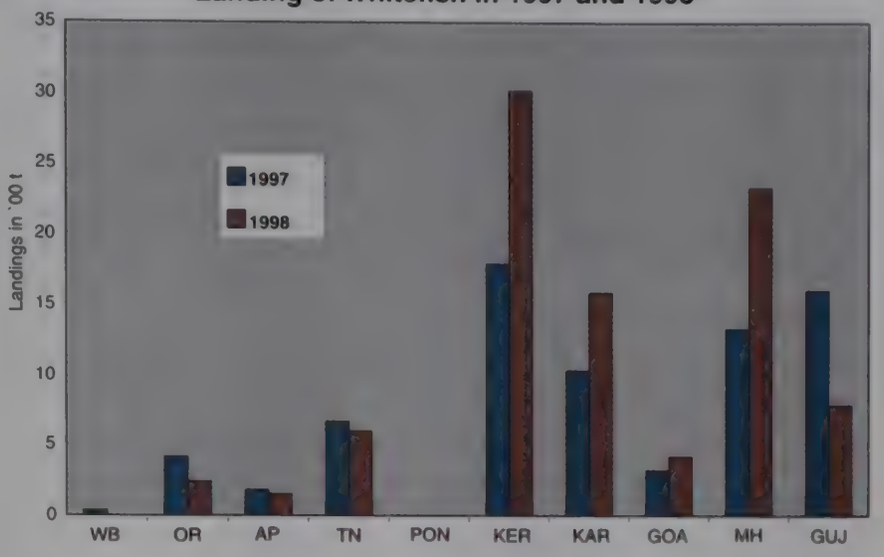
U.sundaicus (50.4% of the goatfish landings) and *U.sulphureus* (42.8%) were dominant in the south Tamilnadu coast (Rameswaram and Pamban). *U.taeniopterus* (47%) was dominant along the north Tamilnadu – south Andhra Pradesh and *U.vittatus* (55.0 to 68.9%) along the north Andhra Pradesh coast.

The length of different species along the east coast ranged from 60 to 189 mm. Along the north Tamil Nadu and Andhra Pradesh coast, the females dominated the catch; crustaceans were the major food of the goatfishes.

WHITEFISH

There was improvement in the landings of the whitefish in all the centres along the southwest coast, especially along the south Karnataka coast, where the catch and CPUE increased by 98% and 133% respectively. The length range of *Lactarius lactarius* was 30-209 mm and females in all stages of gonadal maturity were observed in the catch. Anchovies were the major food of *L. lactarius*.

Landing of Whitefish in 1997 and 1998



Landings of flatfishes at different centres during January - December,1998

Particulars	Mangalore & Malpe	Puthiappa & Beypore***	Cochin	Vizhinjam	Rameswaram	Pamban	Mandapam
CATCH							
Trawl (t)	2333	1019	33	460 **	195	12	71
% difference compared to Jan.-Dec. 97	- 13			+ 65			
CPUE (kg/unit)	0.9 *		1.8		2.9	3.0	2.0
% difference compared to Jan.Dec. 97	- 34						
% in total catch	3.4		0.2		0.7	0.6	1.5

* kg/h ** Catches from *Konchuvala* *** for Jan to.Sep., 1998

Landings of goatfishes at different centres during January - December,1998

Particulars	Vizhinjam	Mandapam	Rameswaram	Pamban	Madras	Visakhapatnam	
					Small trawl		*Sona*
CATCH Trawl (t)	31	209	221	64	1654	252	244
% difference compared to Jan.Dec. 98	-75				+31	+25	-44
CPUE (kg/unit)		6.0	3.3	16.9	1.4 (kg/h)	1.3 (kg/h)	0.8
% difference compared to Jan.Dec. 98					-14	+20	-27
% in all fish catch		4.4	0.8	3.9	4.5	5.7	6.0

Landings of whitefish from trawlers at different centres during January-December,1998

Particulars	Vizhinjam	Mangalore & Malpe	Puthiappa & Beypore
CATCH			
Trawl (t)	10	1063	280
% difference compared			
to January-December,1997	+16	+98	+200
CPUE		0.7 (kg/h)	5.5 (kg/unit)

INVESTIGATIONS ON THE IMPACT OF COASTAL BOTTOM TRAWLING ON DEMERSAL FISHES AND MACROBENTHOS (DF/TR/1)

N.G. Menon, P. Nammalwar, P.U. Zacharia and I. Jagadish

In order to study the impact of coastal bottom trawling on the habitat and resources, the data of 1997 were analysed. In Kerala the estimated target by catch ratio was 33: 67; the non-edible benthic biota formed 7.8 % of the total catch. In Karnataka the above

ratio was 21:78; with the non-edible biota forming 20.6 % of the total catch. In Tamilnadu, the ratio was 17:83 wherein non-edible biota formed only less than 3 % of the total catch. In the total trawl catch of Karnataka 47 % was caught from less than 30-m depth, 34 % from the 30 –50 m depth and 19 % from above 50-m depth. Similarly, in Kerala, 43 % was caught from less than 30 m depth, 38 % from 30 – 50 m depth and 19 % from above 50 m whereas in Tamilnadu 80 % of the trawl catch was from 0-30 m, 15 % from 30 –50 m and only 5 % from above 50 m depth.

The catch particulars pertaining to 1998 are based on estimated data drawn from various centres in the project area. The centre-wise results are given below.

KARWAR

In the small trawlers operating in 20-40m depth, the finfish formed 54% of the total catch of Karwar, crustaceans 28%, cephalopods 0.4% and the benthic biota; the rest, whereas at Tadri, finfish accounted for 49% followed by crustaceans 14%, cephalopods 0.2% and the benthic biota 36.8%.

MANGALORE

The fishing was carried out in shallow grounds of less than 30 m depth by single day fishing and the multiday fishing concentrated in above 30 m depth.

During 1998, the finfish accounted for 49% of the total trawl catch, whereas the target resources constituted 14% and the remaining 37% by the benthic biota. About 12% of the finfish catch consisted of juveniles / sub adults of elasmobranchs, catfishes, lizardfishes, *Epinephelus*, *Lactarius*, silverbellies, sciaenids and flatfishes. The benthic biota consisted of 83% stomatopods, 8% gastropods 4% bivalves, 3% inedible crabs, 2% echinoderms etc.

In the multiday trawling beyond 30 m, finfishes formed 77%, crustaceans 4%, cephalopods 14% and benthic biota 5%. In the total finfish catch juveniles / sub-adults catfishes, lizard fishes, threadfin bream, *Lactarius*, sciaenids, flatfishes contributed about 18%. The benthic biota formed 2054 tons, which included stomatopods (84%), gastropods (3.5%), bivalves (3%), inedible crabs (3.3%), echinoderms (2%) etc.

COCHIN

The trawlers landed 18,042 t, shared by finfishes (97 %)and target resources 2. 9 % at Cochin Fisheries Harbour. The benthic biota formed only very negligible quantity mostly comprising of stomatopods, inedible crabs, gastropods and bivalves. It is reported that the catch is invariably sorted on board the vessel and the nonedible and low value components are discarded in the sea.

Experimental trawling conducted at 10 m depth off Cochin revealed the occurrence of benthic organisms such as stomatopods, gastropods, bivalves, inedible crabs and echinoderms to the tune of 30 % of the catch, silverbellies, sciaenids, flatfishes, lizard fishes (mostly juveniles and sub-adults) were the major catch from this ground.

MANDAPAM

During 1998, the trawlers landed 1642 t from the Gulf of Mannar. Finfishes formed 67.7% of the total catch, followed by crustaceans 9.4%, cephalopods 0.5% and benthic organisms 22.4%. In the finfishes, about 21% constituted juveniles of sciaenids, silver bellies, catfishes, lizardfishes, flatfishes and goatfishes. The benthic biota (368t) comprised mostly of stomatopods, inedible crabs, gastropods bivalves and echinoderms. Other items were sponges, gorgonids and ascidians.

An estimated 2992 t were landed from Palk bay during 1998; which included 68.6% finfishes, 13% crustaceans, 2.8% cephalopods and 15.5% benthic biota. The finfish catches consisted of juvenile and sub adults of catfishes, scianeids, flatfishes, goatfishes and silver bellies to the tune of 28% of the total finfish catch. The catch of benthic biota was dominated by stomatopods, inedible crabs, bivalves, echinoderms and gastropods in the order of abundance. Gorgonids, antipatherians, sponges, ascidians and sea grass/ seaweeds were also taken by trawlers in small quantities.

MADRAS

The trawlers landed 14913 t during April –Dec 1998, of which, finfish accounted for 78.6% followed by crustaceans 4.6%, cephalopods 0.6% and benthic biota 6%. Juvenile / subadults of the threadfin breams, sciaenids, silverbellies and flatfishes were recorded in appreciable quantities. The benthic biota consisted of stomatopods (44%), inedible crabs (37%), gastropods (9%), bivalves (8%) sea urchins, cephalopod juveniles and others.

KAKINADA

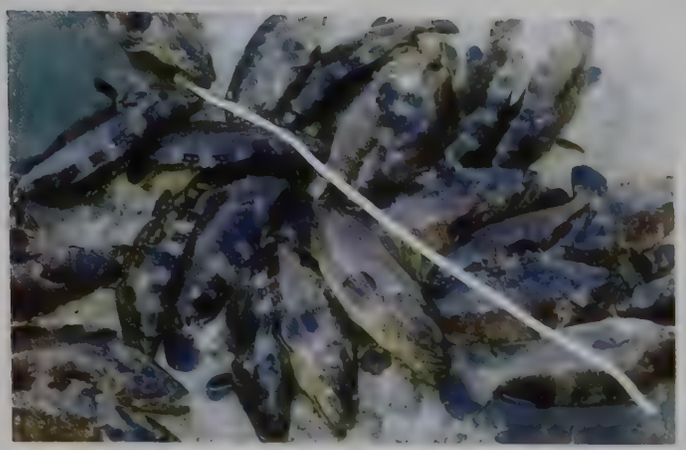
The trawlers landed 37647 t, consisting of 64.6% finfish, 31.6% crustaceans, 1.8% cephalopods and the rest benthic biota. An estimated catch of 582 t of juveniles of finfish were landed during the year. This portion of the catch was dominated by sciaenids (12.5%), flatfish, perches threadfin breams, goatfishes and lizardfishes. The benthic biota landing was to the tune of 779 tons, comprising of 61% inedible crabs, 36% stomatopods, 2.6% gastropods and bivalves, 0.1% echinoderms etc.

CULTURE OF GROUPERS, SEABASS, RABBITFISH AND ORNAMENTAL FISH (DF/CUL/3)

K.V. Somasekharan Nair, V.S. Rengaswamy, K. M. S. Ameer Hamsa, D.C.V. Easterson, A. Raju, V. Gandhi, D. Kandaswamy, I. Rajendran, I. Jagadish, Grace Mathew, N. Sridhar, Manpal Sridhar, Molly Varghese, P.P. Manojkumar and Miriam Paul

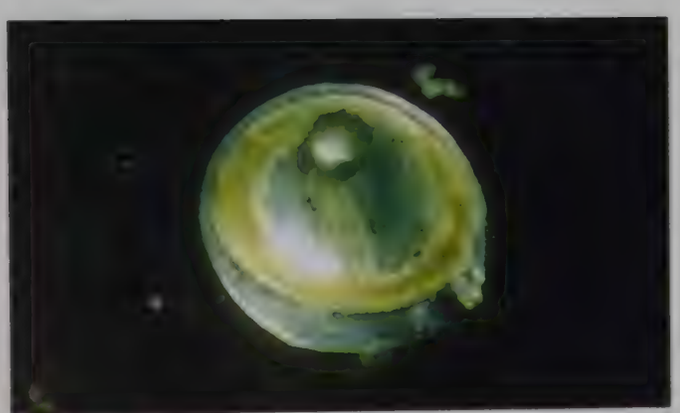
AT COCHIN FISHERIES HARBOUR LABORATORY

Breakthrough in the broodstock development and breeding of grouper: Thirteen specimens of *Epinephelus malabaricus* and five of *E. tauvina* in the length range of 51 - 62 cm and weight range of 2100 - 4800



Live grouper broodstock in the tank just before water change at Mandapam

18 Hour old embryos of *E. tauvina*



Developing embryo of *E. tauvina*

24 Hour old larvae of *E. tauvina*

The clownfish in the Aquarium at Vizhinjam

Freshly-laid eggs of clownfish

A fully grown clownfish larva breaking capsule to wriggle-out

Young ones of clownfish in growout tank

g were stocked at the rate of 2 or 3 numbers at a total biomass of 1-2 kg/sq.m. in 5 tonne capacity FRP tanks in seawater of salinity 32 ppt, pH 7-8 and dissolved oxygen values 3.5-4.5 ml/L. A recirculation system was established inside the tank using *insitu* biofilters. From January onwards, along with the regular feed, the fishes were also given codliver oil and vitamin B12.

A few fishes were selected for sex reversal and *Epinephelus tauvina* and *E. malabaricus* were treated separately. *E. malabaricus* was given 5 mg of the male hormone (17a methyl testosterone), in the form of pellets, through food. The fishes, both the harmone treated and the untreated were exasmined regularly for assessing the gonad maturation. During April 1998, the ova obtained through biopsy were in the diameter range of 260-300m. Supplementary feeding with codliver oil and vitamin B12 was continued; besides, during June and July, the food was further supplemented by the specially formulated maturation diet. Towards the end of September, the ova of *E. tauvina* were in the diameter range of 380-400 m. Administration of male hormone for the fish selected for sex reversal was continued.

On 29-10-1999, *E. tauvina* (male 3100 g, female 3850 g) spawned during 18.00-22.00 hrs in the same 5-tonne tank in which they were maintained throughout. Spawning took place again on the next day (30-10 1998) during almost the same time (19.00-22.00 hrs). The spawn was in the diameter range of 900-920 m with a single oil globule measuring 0.019m. Fertilization was around 98-100%. The eggs were transferred to the incubation tanks; after 22 hrs of development, the larvae hatched; which measured 1.64-1.70 mm.

Another female weighing 4700 g (and the male in the above pair) spawned on 20.12.98, producing 0.25 million eggs of 860-900 m diameter; the hatching rate was 45% and the larvae survived upto 4th day.

The achievements in the experiments are:

- successful rearing, from fingerlings, of groupers and development of broodstock in onshore, fully controlled, seawater recirculating system,
- sex reversal, maturation and spontaneous spawning under onshore captive conditions, and
- successful fertilization and larval hatching.

The results offer vast scope for developing a technology package for broodstock development, breeding, seed production and growout culture of groupers in India.

AT NARAKKAL

Epinephelus tauvina and *E.malabaricus* were reared in two silpaulin-lined ponds of 70 and 65-tonne capacity and one earthern pond of 0.3 ha, in an attempt to raise broodstock. In the silpaulin - lined ponds, water quality was maintained by effecting daily exchange (30-40%) of water.

Water temperature, salinity, dissolved

oxygen, ammonia, nitrate etc. were regularly monitored. The salinity in the silpaulin lined ponds ranged between 16.5 and 34.5 ppt and that of natural ponds between 6.0 and 18.7 ppt. During monsoon months salinity values in all the ponds showed a sharp decline due to rain water. The dissolved oxygen values ranged between 4.31 and 6.80 ml/L and from 1.58 to 6.10 ml/L in silpaulin lined and natural ponds respectively. Occurrence of nitrate and ammonia was negligible.

For induced maturation and sex inversion, two specimens of *E. tauvina* weighing about 2.5 kg were kept separately in a 70-tonne silpaulin -lined pond. 17a methyl testosterone pellets were given orally for sex inversion at weekly intervals for a period of two months. However, optimum salinity for maturation and sex inversion of the species could not be maintained in the pond during monsoon.

AT MANDAPAM

Live groupers (*Epinephelus tauvina*) of varying lengths, caught by traps from the wild were stocked in RCC tanks of 100-tonne capacity at the rate of 1kg biomass, per cubic meter. Besides, pond-harvested fishes trasnsported from Tuticorin, were also maintained in the RCC tanks of the same capacity seperately. 100% water exchange with water drawn directly from the sea was done after cleaning the tanks twice in a week, in addition to 50% exchange daily. Fresh sardines were given as food supplemented with codliver oil and vitamin E .

A stock of 75 specimens of 3 size groups (less than 1 kg, 1-2 kg and over 2 kg) were maintained in RCC tanks. By June, the average sizes were 381.5mm (742 g), 472.3 mm (1515 g) and 560 mm (2600 g). On completion of another six months in December, they attained average sizes of 442.6 mm (1383 g), 550.9 mm(2480 g) and 620mm(3670 g). The feed conversion ratio ranged from 4.6 to 7.7. Growth in weight was greater in October and November. It was observed that fishes weighing more than 1 kg grew well with less food conversion ratio.

Another stock of 120 groupers harvested from the culture ponds at Tuticorin Research Centre, were raised by stocking them in three categories(less than 0.5 kg, 0.5-1.0 kg and over 1 kg) in three tanks of size 10 x 5 x 2.3 m. After four months, in December, they progressed to an average size of 383.2 mm

RCC tank at Mandapam for grouper broodstock development

(791 g), 456.1 mm (1485 g) and 551.7 mm (2622 g) as against the initial stocking sizes of 298.8 mm (324 g), 389.7 mm (755 g) and 481.8 mm (1534 g) respectively. The monthly average increase in size was 21.1 mm(116.8 g), 16.6 mm (182.5 g) and 17.5 mm (271.5 g) with a feed conversion ratio of 3.2, 3.3 and 3.5 respectively.

Juveniles measuring average size of 69.8 mm (4.5 g) were reared in a 30-tonne capacity RCC tank feeding them with chopped sardine at the rate of 6-8% of the body weight. After nine months they attained an average size of 284.6mm (377g).

Experiments were conducted with six female groupers measuring 60 – 68 cm (3.4-5.4 kg) to convert them into males using hormone. They were injected with methyl testosterone at the rate of 2 mg per Kg body weight. There was no mortality due to injections for three months. The intake of food was poor latter and they became sluggish and the colour changed to dark brown ultimately leading to the death of four specimens.

AT TUTICORIN

The Grouper seed was obtained throughout the year with the peak occurrence during October-December. About 1620 seed was collected using mini shoreseine from Vellapatti area. 800 specimens of *Epinephelus tauvina* of an average size of 130 mm (28 g) were stocked in an earthen pond. They showed an average monthly growth rate of 12 mm (48 g). The total number harvested was 280, the survival rate being 35%. About 150 specimens were transported to Mandapam Camp for breeding experiments.

After harvest, the pond was restocked with groupers at the rate of 2700 numbers/ hectare. The mean stocking size was 140 mm (34 g).

AT VIZHINJAM

The clownfish (*Amphiprion chrysogaster*) (8-9 cm) collected from the wild were maintained in FRP tanks. These fishes spawned frequently at intervals of 10-45 days in the tanks, the number of eggs ranging from 300 to 800 on different occasions. Hatching took place after 6-7 days during night (19.00 – 22.00 hrs). The length of the newly hatched larvae ranged from 2.5 to 3.0 mm and they were given livefeed (*Brachionus rotundiformis* and *Artemia* nauplii). The larvae metamorphosed into juveniles of average length of 8 mm, after 12-15 days of hatching. The juveniles were transferred to rearing tanks for growout .

IV. CRUSTACEAN FISHERIES DIVISION

Crustacean production in 1998 was estimated at 5,06,694 t, showing an increase of 0.7% over the previous year; they formed 18.6% of the marine fish landings in 1998. Penaeid prawns with a production of 2,17,076t contributed to 42.8% of the crustacean landings followed by nonpenaeids (184436 t, 36.40%), stomatopods (67601 t, 13.34%), crabs (34814 t, 6.87%) and lobsters (2767 t, 0.55%). When compared with the previous year, penaeid and nonpenaeid landings increased by 5.2% and 19.8% whereas those of lobsters declined by 5.2%, crabs 25.9% and stomatopods 27.3%. The west coast contributed 75.3% of the penaeids and the northwest coast supported 93% of the nonpenaeid fishery. Penaeid prawn fishery registered moderate increase in the landings in Kerala and considerable increase in Gujarat and Andhra Pradesh.

ASSESSMENT OF FISHERY AND RESOURCE CHARACTERISTICS OF PENAEID SHRIMP OF THE WEST COAST OF INDIA (CF/RE/1.11)

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With a total production of 1,63,554 t in 1998, the west coast contributed to 75.3% of the penaeid prawn fishery of the country. Over the previous year, the fishery improved by 5.1%. The contribution of states to the fishery was 35.8% by Kerala, 4% by Karnataka, 1% by Goa, 27.5% by Maharashtra and 31.7% by Gujarat. Against the previous year, fishery in 1998 improved by 4.3% in Kerala and 39.3% in Gujarat. Fishery declined by 31.3% in Karnataka, 40.8% in Goa and 9.7% in Maharashtra.

Trawl fishery

Trawlers accounted for major portion of the catch. Investigations were carried out at Veraval, New Ferry Wharf (Mumbai), Karwar, Tadri, Malpe, Mangalore, Kozhikode, Kochi and Sakthikulangara (Neendakara).

Estimated penaeid prawn catch and catch rate (in parentheses) in 1998 at trawl landing centres were 3738 t (5.0 kg/hr) at Veraval, 9259 t (6.0 kg/hr) at New Ferry Wharf, 511 t (7.0 kg/hr) at Karwar, 361 t (3.4 kg/hr) at Tadri, 744 t (1.6 kg/hr) at Malpe, 1358 t (1.3 kg/hr) at Mangalore, 1558 (47.7 kg/boat trip) at Kozhikode, 5781 t (8.6 kg/hr) at Kochi and 11066 t (7.0 kg/hr) at Sakthikulangara. When compared to the previous year, the fishery declined by 30% at Veraval, 55% at Mumbai, 63% at Karwar, 44% at Tadri, 29% at Mangalore 28% at Malpe 16% at Kozhikode and 10% at Kochi. However, at Sakthikulangara, 9% increase in the fishery was recorded.

Karikkadi fishery in the monsoon period

amounted to 1084 t at Kochi and 4819 t at Sakthikulangara showing improvement of 41% at Sakthikulangara and decline of 13% at Kochi over the previous year.

P. stylifera was the dominant constituent at most of the centres. This species contributed to 56% at Veraval, 42% at New Ferry Wharf, 43% at Karwar, 65% at Tadri, 36% at Malpe, 33% at Kozhikode, 41% at Kochi and 56% at Sakthikulangara. *Metapenaeus monoceros* (44%) was the major component at Mangalore. This species supported sizeable fishery at Malpe (25%) and Tadri (15%) too. *Metapenaeus dobsoni* was fished in large quantities at Karwar (41%), Tadri (12%), Malpe (17%), Mangalore (7%), Kozhikode (32%) and Kochi (34%).

Along the northwest coast *Solenocera crassicornis* at Veraval (27%) and New Ferry Wharf (16%), *Metapenaeus kutchensis* at Veraval (4%) and New Ferry Wharf (4%), *Metapenaeus affinis* (13%), *Metapenaeopsis stridulans* (8%) and *M. monoceros* (6%) at Mumbai were fished in fairly large quantities. In the southwest coast, at Sakthikulangara, *Trachypenaeus curvirostris* (23%) was the second most abundant species. In recent years, with advancement of trawling into deeper grounds, *Solenocera choprai* has emerged as a potential resource at Mangalore (12%) and Sakthikulangara (4%).

Larger species like *Penaeus semisulcatus* at Veraval, *P. merguiensis* at New Ferry Wharf, Karwar and Tadri, *P. canaliculatus* at Sakthikulangara and *P. indicus* along the Kerala coast supported minor fisheries.

Size classes (combined for both sexes) dominating the *P. stylifera* fishery were 76-120 mm at Veraval, 71-115 mm at New Ferry Wharf, 71-90 mm at Karwar and Tadri, 76-110 mm at Malpe and Mangalore. Along the Kerala coast, smaller prawns within the range 61-90 mm in length were predominant.

In *M. dobsoni*, bulk of the fishery was supported by 81-100 mm sizes at Karwar, 76-85 mm at Tadri, 61-85 mm at Mangalore, 61-95 mm at Malpe and 61-85 mm at Kochi.

M. monoceros fishery along the Mangalore coast was dominated by 101-130 mm size at Mangalore and 111-155 mmat Malpe.

All along the west coast, peak spawning season for *P. stylifera*, *M. dobsoni* and *M. monoceros* was between December and May.

Purse seiners at Malpe and Mangalore landed 29 t of *M. dobsoni* in July. Fishery suffered a decline of 87% over the previous year.

Artisanal prawn fishery

In the artisanal sector, fishery was active in the monsoon period. At Calicut, ringseines, disco nets and pairtrawls together landed 144 t registering an increase of 275 % over the previous year.

At Fort Kochi, ringseines landed a paltry 3 t of prawns at a catch rate of 1 kg/unit. The entire fishery was supported by *M. dobsoni*.

Prawn fishery in the Mudbank along Trichur District was dominated by *M. dobsoni*.

81-105 mm sizes in females and 71-90 mm in males supported the fishery. Spawners formed nearly 35%.

'Konchu vala' operations at Vizhinjam and Manakudy in the southern most part of Kerala landed 68 t (3 kg/unit) of prawns showing a decline of 51% over the previous year. *P.indicus* (67%) followed by *P.canaliculatus* (11%), *P. monodon* (12%) and *P. semisulcatus* (7%) were the major component species. *P. indicus* fishery was supported mostly by 141-175 mm groups. Between July and September 50 - 54% of the females were in ripe condition.

Prawn fishery in the nursery grounds:

Stake nets operating in Kochi backwaters landed 281 t of juvenile prawns at a catch rate of 4.3 kg/unit. Fishery improved by 12% over the previous year. *M. dobsoni* (86%) dominated the fishery.

ASSESSMENT OF FISHERY AND RESOURCE CHARACTERISTICS OF PENAEID SHRIMPS OF THE EAST COAST OF INDIA (CF/RE/1.12)

G. Sudhakara Rao, M. Rajamani, V.Thangaraj Subramanian, K.N. Saleela and G. Maheswarudu

Penaeid prawn production along east coast in 1998 was estimated at 53253 t registering an increase of 5.5% over the previous year. East coast contributed to 24.5 % of the country's penaeid prawn production. Statewise contribution to the east coast fishery, in order of abundance, was 53.2% in Tamilnadu, 35.7% in Andhra Pradesh, 5.9% in West Bengal, 3.9% in Orissa and 1.3% in Pondicherry. Against the previous year, fishery improved by 27.9% in Andhra Pradesh, 3.1% in West Bengal and 5.7% in Pondicherry. Marginal decrease of 4% in Tamilnadu and a substantial decline of 30.2% in Orissa were recorded in 1998.

Trawl fishery

Data were collected at Tuticorin, Mandapam, Chennai, Kakinada, Visakhapatnam and Paradeep.

Estimated penaeid prawn catch and catch rate in 1998-99 at important trawling centres were 53 t (3.4 kg/boat trip) at Tuticorin, 756 t (1.5 kg/hr) at Mandapam, 3534 t (3.1 kg/hr) at Chennai, 8711 t (8.8 kg/hr) at Kakinada, 516 t (2.5 kg/hr) at Visakhapatnam and 489 t (5.1 kg/hr) at Paradeep. In comparison to the previous year, the catches declined by 33% at Tuticorin and 32% at Paradeep while the fishery improved by 5% at Mandapam, 30% at Chennai, 24% at Kakinada and 22% at Visakhapatnam. Poor landings of *Penaeus semisulcatus* at Tuticorin and *Parapenaeopsis hardwickii*, *Metapenaeus dobsoni* and *Parapenaeopsis stylifera* at Paradeep resulted in the decline of the fishery in these centres. Fishery improved at Chennai, Kakinada and Visakhapatnam due to increased landings of *M. dobsoni* and *Penaeus indicus* at the former centre and *Metapenaeus monoceros* and

M. dobsoni at the latter two centres.

Along the Tamilnadu coast, *P. semisulcatus* (76%) at Tuticorin and *P. semisulcatus* (62%) and *Metapenaeopsis stridulans* (25%) at Mandapam and *M. dobsoni* (23%) and *P. indicus* (16%) at Chennai were the dominant species. In Andhra Pradesh *M. dobsoni* (35%) and *Metapenaeus monoceros* (33%) at Kakinada and *M. monoceros* (37%) and *M. dobsoni* (22%) at Visakhapatnam were the principal components of the fishery. At Paradeep in Orissa, the fishery was dominated by *Parapenaeopsis hardwickii* (30%) and *M. dobsoni* (20%). In addition to the above species *Trachypenaeus pescadorensis* (6%) at Mandapam, *Parapenaeopsis maxillipedo* (11%), *M. monoceros* (9%) and *P. semisulcatus* (5%) at Chennai, *Metapenaeus brevicornis* (7%), *Solenocera crassicornis* (5%) at Kakinada, *Metapenaeopsis* spp. (6%), *Solenocera* spp. (17%) at Visakhapatnam and *P. stylifera* (12%), *M. monoceros* (8%) and *M. lysianassa* (8%) at Paradeep added substantially to the penaeid fishery of the east coast.

In *P. semisulcatus* the dominant length range was 106-130 mm at Mandapam; January-March was the peak spawning season of this species.

In *M. dobsoni*, 71-90 mm sizes at Chennai, 61-80 mm at Kakinada and 66-90 mm supported the bulk of the fishery.

111-155 mm and 106-135 mm sizes in *M. monoceros* mainly supported the fishery at Visakhapatnam and Paradeep respectively. A disturbing feature of *M. monoceros* fishery at Kakinada was the dominance of undersized prawns in the landings. Prawns less than 100 mm length contributed to 83% of the fishery. October to February was the peak spawning season of *M. monoceros* along the Andhra coast.

Prawn fishery by *Sona* boats

Sona boats (13.1 m OAL) operating off Visakhapatnam landed 935 t (3.4 kg/hr) of penaeid prawns during 1998 showing 41% increase over the previous year. *M. dobsoni* (43%), *M. monoceros* (20%) and *Metapenaeopsis* spp. (5%) were the dominant constituents of the fishery.

An analysis of the prawn fishery by *Sona* boats for the period 1993 to 1997 indicates the dominance of *M. monoceros* (24-30%) followed by *M. dobsoni* (12-35%), *M. affinis* (3-18%), *P. indicus* (8-15%), *P. monodon* (3-6%) and *P. semisulcatus* (1%). While there are indications of overfishing in *M. affinis* and *P. monodon*, the stocks of other species were in a healthy state of exploitation. *Sona* boats being highly coast-effective pose a threat to the economic viability of other fishing fleets. Hence no further increase in the number of *Sona* boats is recommended.

Artisanal prawn fishery

'Thallumadi' operations at Tuticorin and 'Thalluvalai' fishing at Mandapam landed 28t (3 kg/unit) and 11 t (0.3 kg/unit) of prawns showing improved landings of 33% and 63% over the previous year. Juveniles of *P. semisulcatus* dominated the fishery at both centres.

Gillnets and disco nets at Puri 49 t (0.4 kg/hr) of prawns registering a decline of 50% in the catches over the previous year. *P. indicus* (75%) and *M. affinis* (19%) were the major components of the fishery.

Prawn fishery in the nursery grounds

Stake nets at B.V. Palem (Kakinada) landed 305 t (2.7 kg/hr) of juvenile prawns dominated by *M. monoceros* (52%) and *M. dobsoni* (30%). Fishery improved by 83% over the previous year.

INVESTIGATIONS ON THE NONPENAEID SHRIMP FISHERY OF NORTHWEST COAST OF INDIA (CF/RE/1.13)

V.D. Deshmukh and A.P. Dineshbabu

Nonpenaeid prawn landings in the country in 1998 were estimated at 1,73,942 t against 1,53,959 t in the previous year, showing an improvement of 19.8% in 1998. Gujarat (53.11%) and Maharashtra (40.01%) contributed the bulk of nonpenaeid prawn production in the country. Fishery in 1998 improved by 24.12% in Maharashtra and 13.4% in Gujarat over the previous year. West Bengal (4.68%) and Andhra Pradesh (1.70%) were the other two states where this resource was exploited in moderate quantities.

Trawl fishery

At Veraval, an estimated 14,958 t of nonpenaeids at a catch rate of 20 kg/hr were landed during the year. Over the previous year, the fishery registered a decline of 62%. *Acetes* spp. contributed to 99% of the catch and the rest being *Nematopalaemon tenuipes*.

Trawlers at in Mumbai landed 2646 t of nonpenaeids The entire fishery was contributed by *N. tenuipes*.

While *Acetes* spp. supported almost the entire fishery in trawlers in Gujarat, their place was taken by *N. tenuipes* in Maharashtra. *Exhippolysmata ensirostris* was landed in small quantities in Maharashtra.

Dol net fishery; *Dol* netters at Nawabunder and Rajpara in Gujarat landed 5411 t (31 kg/haul) and 6375 t (29 kg/haul) of nonpenaeids respectively. The fishery improved by 32% at Nawabunder whereas a decline of 7% was recorded at Rajpara over the previous year. *Acetes* spp was the main component at both the centres, the percentage contribution being 85 at Nawabunder and 77 at Rajpara. *N. tenuipes* supported 7% and 11% of the fishery at Nawabunder and Rajpara respectively. *E. ensirostris* accounted for the rest of the fishery at these centres.

In Maharashtra, *dol* nets landed 1127 t at Mumbai about 80% of the landings were contributed by *Acetes* spp. *N. tenuipes* and *E. ensirostris* contributed to the rest. *N. tenuipes* fishery was dominated by 39-51 mm sizes in *dol* nets and 45-63 mm in trawl nets in

Maharashtra. January to April was the peak spawning season for this species. In *E. ensirostris* 73-88 mm sizes were dominant in *dol* net catches at Nawabunder.

Mortality coefficient (Z) of *N. tenuipes* at Mumbai was estimated as 11.1 and 9.35 respectively for males and females. Exploitation rate, standing stock and total biomass were 0.64, 436.5 t and 4357 t respectively during the year. Exploitation rate was above the optimum level and hence reduction in effort is recommended.

INVESTIGATIONS ON LOBSTER AND CRAB RESOURCES OF INDIAN COAST (CF/RE/1.14)

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LOBSTERS

The total landing of lobsters in India during the year 1998 was 2694 t as against 2917 t during the previous year. In Gujarat (except Kutch) the fishery declined from 1405 t in 1997 to 1054 t in 1998. A decline was noticed in Maharashtra also where the catches recorded were 818 t and 442 t in 1997 and 1998, respectively. There was no landing in Goa and Karnataka whereas Kerala registered a decline from 265 t in the previous year to 64 t in the current year. However, the lobster fishery showed a slight improvement along the east coast. In Tamil Nadu the catches increased from 375 t in 1997 to 998 t in 1998, in Andhra Pradesh, from 1 t in 1997 to 12 t in 1998 and in West Bengal from 6 t in 1997 to 89 t in 1998. Maximum landing was recorded in Gujarat (39.64%) where trawl net was the major gear operated. Tamilnadu contributed to 37.5%, Maharashtra, 16.6%, West Bengal, 3.3% and Kerala 2.4%. Maximum landing (46.1%) was recorded during the first quarter of the year. 9.7% of the catch was landed during the second quarter, 17.6% during the third quarter and 26.5% during the fourth quarter. Thus the peak season was from October to March. A regionwise analysis of the data shows that better catches were obtained from the northwest coast (56.2%) followed by the southeast coast (38%).

Studies were carried out on the fishery and biology of important edible species of lobsters at Veraval, Mumbai, Calicut, Vizhinjam and Tuticorin. Traps and trawl net are the major gears operated. Artisanal gears such as bottom-set gillnets and traps are extensively used at Calicut, Vizhinjam and Tuticorin. *Panulirus polyphagus* and *Thenus orientalis* contributed to the fishery at Veraval. 90.6 t of lobsters were landed at a catch per unit effort of 1.28 kg. The fishery showed a decline when compared to that of the previous year. *P. polyphagus* predominated the fishery

contributing to 55.6% of the total landing. Maximum landing of *P. polyphagus* was reported in December-January and that of *T. orientalis* in November-January. In *P. polyphagus*, females were predominant in the population forming 68.8% . Of this 33.8% were in berried condition, with maximum in May. The modal length classes for males and females were at 71-80 mm and 76-85 mm, respectively. In the case of *T. orientalis* males predominated the population contributing to 54.6%. The modal length classes for males and females were at 61-65 mm and 71-75 mm, respectively. At Mumbai about 94 t of lobsters were landed at a catch rate of 3.36 kg per boat trip. This formed 0.21% of the total fish landed by trawl. When compared to the catch of the previous year, the lobster landing showed an increase by 26.8%. The catch was constituted by a single species, *P. polyphagus*. At Thikkode, Calicut, bottom set gill nets landed 1887 kg of lobsters at a CPUE of 0.05 kg, in 1998. The catches declined by 6.6% when compared with that of the previous year. *P. homarus* predominated the fishery (85.4%), followed by *P. ornatus*, *P. polyphagus* and *P. versicolar*. In *P. homarus*, the modal size in both males and females ranged from 61 to 70 mm carapace length.

The estimated total landing of lobsters at Vizhinjam during 1998 was 1.3 t and *P. homarus* was dominant. At Muttom the total landing of lobsters was 6.5 t at a CPUE of 0.87 kg. The modal sizes of *P. homarus* were at 56-60 mm CL in males and 71-75 mm CL in females. Berried specimens formed 18.4% of the female population. The estimated lobster landings at Tuticorin by trawl nets, during the year was 4.8 t at a CPUE of 0.16 kg. This showed a decline when compared to the previous year. The peak season was in the months of June-July. *P. ornatus* predominated the fishery (72.44%). Males showed dominance throughout the year and no berried females reported from the female population. At Tharuvaikulam, Tuticorin, bottom set gill nets landed 2.5 t of lobsters at a CPUE of 0.33 kg. Here also a decline was noticed when compared with the previous year's catch. The peak season fell in the month of January. *P. ornatus* predominated the fishery forming 64.74%. No berried females were noticed in *P. ornatus* whereas berried females were available in April and July, in the case of *P. homarus*.

CRABS

The total crab production in the country declined from 46,817 t in 1997 to 34,715 t in 1998. Tamilnadu (12913 t), Gujarat (except Kutch) (8300 t) and Kerala (6985 t) recorded maximum landings, contributing to 37.5%, 24.1% and 20.3%, respectively. The landing in Andhra Pradesh was 3326 t (9.6%). In Tamilnadu, catches decreased from 13,394 t in 1997 to 12913 t in 1998. In Gujarat and Kerala also decline was recorded from 14148 t to 8300 t, and from 10,438 t to 6985 t, respectively. Slight improvement was noticed in the fishery in Andhra Pradesh. Analysis of the data showed that catches were better during the first quarter of the year (36.3%).

Minimum landing was obtained during the third quarter (15.7%). A regionwise analysis of the data showed that maximum catches were recorded from the southeast coast (47.8%) followed by northwest (25.4%) and southwest (23.2%) coasts. Minimum landing was recorded from the northeast coast (3.4%).

At Veraval, the total landing of crabs was about 1099 t, at a CPUE of 15.6 kg. A good portion of the crabs were landed by multi-day trawlers in a decomposed state and were used as fish meal or manure. *Charybdis cruciata* predominated the catches. The modal size class in males was 61-65 mm and females 56-60 mm. The total estimated catch of crabs at Mumbai was 205 t at a CPUE of 7.3kg. This showed a 37% decline when compared to the landings of the previous year. *C. cruciata* contributing to 64% predominated the catches. The crab fishery was of a lesser magnitude at Karwar, the landing being about 27t. The species *P. pelagicus* predominated the fishery. Crab fishery showed a trend of decline along the Mangalore-Malpe coast landing about 94t of crabs. *P. sanguinolentus* predominated the fishery.

The total estimated catch of crabs at Calicut in the year 1998 was 282 t. *C. cruciata* predominated the catches constituting about 60% of the total landing. A good fishery for crabs was reported during January-May. The total catch of crabs at Cochin was 205 t. Of this 173 t was landed by multiday trawlers and 10 t by hand trawlers. Crabs were also landed by single day trips. *C. cruciata* and *P. sanguinolentus* predominated the landings. In *C. cruciata*, the modal class of males was at 71-75 mm and that of females at 66-70 mm size groups. In the case of *P. sanguinolentus*, the modal sizes were at 101-105 mm and 106-110 mm for males and females respectively. Nearly 60% of females of this species were in berried condition in the month of April. At Vizhinjam, about 30 t of crabs comprising mainly *P. sanguinolentus* were landed by 'Konchuvala' units, at a CPUE of 1.7 kg.

At Tuticorin, the crab landing was estimated at 77 t; the peak was in November. *P. pelagicus* formed 93%. Berried females were present in all the months, with a maximum of 19% in September. At Mandapam, 260t of crabs were landed. *P. pelagicus* was the only species in the trawlers. At Thoppukkadu, nearly 2 t of *Scylla tranquebarica* were landed, at Chennai an estimated 1730 t were landed at a CPH of 1.3 kg, by the trawlers. Maximum landing was recorded in January-February. *P. sanguinolentus* was dominant (47%). *P. vigil* (5%) and *C. smithi* (1%), reappeared in small numbers. Recruitment to the fishery took place during January-February and July-September. The small trawlers at Kakinada landed 689 t. Of this 52.8% was constituted by edible crabs, predominated by *P. sanguinolentus*. The price of crabs varied from Rs.10/- to Rs. 300/- depending on the size as well as species involved.

DEVELOPMENT OF ARTIFICIAL REEFS (CF/RE/3)

M. Rajamani and K.K. Philippose

Two experimental artificial habitats were constructed in the tidal zone of the Tuticorin Bay. The first one was constructed with 24 hollow blocks in the Karapad Bay in September '98, covering an area of 3 sq. m. 46 nos of portunid crab *Thalamita crenata* were recorded from these artificial habitats in course of 6 samplings. One *Charybdis cruciata* was caught in December. 60% of *T. crenata* were berried indicating that the reef served as a good breeding ground. One of the berrid crabs collected from the reefs released zoea within 2 days after collection. Juvenile fishes of commercial importance such as *Epinephelus tauvina, Lutianus fulviflamma, Etroplus suratensis* and *Siganus javus* were also collected from the artificial reefs. The presence of juveniles indicate that the artificial habitat acts as a good nursery ground for these species. In addition to fishes and shrimps, *Trochus* sp. *Alphaeus* spp. and brittle stars *Ophionemis marmorata* were also collected from the reefs.

The second artificial habitat was created in the Tuticorin Bay in December '98. This was constructed of 300 concrete hollow blocks of three different sizes. In course of 6 samplings 4 species of crabs and 8 species of fishes were recorded. Among crabs *T. crenata* and *Scylla oceanica* and among fishes *Siganus javus* and *Lutianus fulviflamma* were dominant in the reef areas.

The artificial reef constructed for lobsters off Vellapatti in the previous year became a good fishing ground for *Panulirus ornatus* and *P. homarus*.

Another artificial reef of 10,000 m^2 was created off poovar in the Trivandrum district. This reef was designed in an oval shape using triangular concrete modules. The length of the reef perimeter was 140 m and width 72 m. Inside the oval reef mini reefs or sets were developed using triangular tubular modules, tyres mounted on concrete slabs, palm leaves and fresh twigs in bundles. A total of 111 triangular modules, 22 tubular modules 16 tyre modules, 80 bundles of palm leaves and 40 bundles of fresh twigs were used in the reef work. The reef was installed on 14.3.1999 with the participation of local fishermen and the Fisheries Department of Kerala.

The performance of the CMFRI reef off Vizhinjam was assessed during the month of April 1998 and it was reported that this reef gave a net earning of about Rs.600,000 to the local fishermen by way of fish catches. The major species that contributed to the fishery were *Sepia pharaonis, Selar crumenopthalmus, Caranx* spp. and *Epinephelus* spp. Besides this, large accumulation of ornamental fishes was also reported in this reef.

SEED PRODUCTION, EXPERIMENTAL FARMING AND TAGGING OF MARINE PRAWNS (CF/CUL/1.9)

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Under this project, experiments were carried out on the induced maturation, hatchery production of seed, as well as farming of commercially important species *P.semisulcatus*, *P. merguiensis* and *P. monodon*.

In the case of *P. monodon*, females of 110 - 150 g size and males of 70-75 g size were collected from trawl catches. They were brought to the laboratory at Mandapam Camp and given an initial formalin treatment (50 ppm) and stocked in the rematuration system of 5 t capacity. Salinity was maintained between 30-35‰. Using heaters, the temperature was maintained at 28°C. Three females and two males were stocked in one rematuration unit. Animals were fed with oligochaetes and squid meat. After two days of acclimatisation females were induced to mature by unilateral eyestalk ablation. Sometimes eyestalk ablation promoted moulting, instead of maturation and it was observed that it has helped to shorten the moult cycle duration (Average 13 days). After moulting, artificial insemination was done in females were found to be not impregnated. This techniques was perfected during this period. Through induced maturation, one female spawned and yielded 75000 nauplii. Another female spawned 12 times in a period of 102 days and gave 35, 18,000 nauplii. Thus, a total of 35,93,000 nauplii were obtained through induced maturation during this period. Nauplii per spawner ranged from 45000 to 6,25,000. A total of 87,360 postlarvae-15 produced through artificial insemination were used to carry out growout experiments.

Succeeded for the first time in the induced maturation and spawning of farmraised *Penaeus merguiensis* under captive conditions at Karwar. The experiments

Artificial insemination of *Penaeus monodon* at Mandapam Camp

were carried out using farm-raised prawns from estuarine environment. 20-25 g size shrimps were collected and acclimatised to 27 ppt for 6 hrs. After acclimatisation unilateral eyestalk ablation was carried out on healthy females. 10 ablated females and 5 males were stocked in a velon screen netcage. The cage was kept submerged in the bay where marine conditions prevailed. Experiment was carried out for 10 days. Clam and squid meat were given as food. Salinity varied from 25-29 ‰ and temperature 26-30°C. No mortality was observed and within 3-6 days 70 % of the females matured and spawned releasing healthy nauplii.

From two spawners of *P. semisulcatus* 2,28,000 nauplii were obtained with a hatching rate of 78.5% and 91% respectively. 45,500 postlarvae-29 were produced under controlled conditions and they were used for growout experiments. Seven such experiments were carried out during this period. In the earlier experiments at Mandapam, the early growth in marine conditions was comparable to that of other commercially important prawns but, the growth was stagnating after reaching a length of 85 -100 mm. In the present experiments, however, this problem did not occur because of better water and feed management. Seed of *P. semisulcatus* was stocked in ponds of 2500 m^2 water area at stocking rates of 7/m^2 and 10/m^2. They were fed with prepared feed and after 60 days, regular water exchange was carried out once in every 15 days. Initial experiments revealed that compared to the stocking rate of 10/m^2 better growth and survival was observed when the stocking rate was 7/m^2. In one experiment 208 kg was harvested after 150 days from 2500 m^2 water area and Rs.41,600 was realised as revenue. Expenditure towards fertilizer, feed and diesel came to 32,400 and the profit was Rs.9200/-.

In another experiment, *P. monodon* was stocked at the rate of 8/m^2 in a pond of 2500 m^2 water area. Water and feed management was same as followed for *P. semisulcatus*. Harvesting was carried out after 150 days. Average weight of the harvested prawn was 30 g. Survival was 85.9% and the total production amounted to 515.75 kg (i.e. @ of 2 t/ha). A sum of Rs.1.7 lakh was obtained by the sale of prawns. Expenditure towards fertilizer, feed and diesel was Rs.69,950 and the profit was Rs.1,03,239/-.

A marine hatchery complex has been established at Calicut and an experiment was initiated to develop a broodstock of *Penaeus japonicus* from juveniles (8 to 10 cm TL) collected from Korapuzha estuary.

Steps were taken to establish a bacteriology laboratory at Mandapam Camp. The bacterial load of the culture system was monitored ; it was expressed in terms of total aerobic plate count. The results of the tests carried out indicated the absence of any

pathogenic bacteria in the culture system at Mandapam shrimp hatchery and ponds. There was no disease outbreak in the stock maintained during this period.

About half of the zooplankton collected from the Minicoy lagoon consisted of crustacean larvae. A total of 67000 larvae were collected of which 92.6% were shrimp larvae (mainly protozoea and mysis larvae) and the rest zoea and megalopa of crabs. Maximum shrimp larvae were observed during May followed by December and January and crab larvae in March and July. Rearing experiments were also carried out using postlarvae of *P. latisulcatus* and *P. canaliculatus* collected from the Minicoy lagoon. In the case of *P. latisulcatus*, an average of 13 mm growth/ month was observed during the first 3 months. In *P. canaliculatus* 14 mm growth was noted in the first month which reduced to 11 mm during the second month.

Experiments on the maintenance and development of *Metapenaeus monoceros* a potential species for marine aquaculture is underway at Narakkal laboratory.

Experiments were conducted on the culture of livefeed organisms (*Brachionus rotundiformis, Moina micrura* and *Caridena longirostris*). A steady culture of *Isochrysis* sp. (at a concentration of 1.5 to 2.5 million cells/ ml) as food to *B. rotundiforms*, and *Chlorella* sp. to caridina larvae and *M. micrura* were also maintained. Diatom culture was maintained in diffused Sunlight at a light intensity of 600-25000 lux and at a temperature of 28-32°C during the course of the experiment. No aeration was provided.

Brachionus rotundiformis was reared in sea water of 29-30‰. At an initial stocking rate of 12 /ml (7000 in 600 ml) an average 29-fold increase in number was obtained in 48-50 hrs (2,03,000 nos in 1600 ml). No aeration was provided. Initially the feed concentration in the rearing medium was maintained at 1.8 million cells/ml which was reduced to 0.22 million cells/ml due to foraging within 24 hrs. After 24 hrs, the cell concentration in the medium was made upto 1.8 million cells/ml by adding pure diatom culture. Within 48-50 hrs, the concentration of rotifer in the medium reached an average number of 136/ml (Range 98 to 168 /ml). Experiments on rearing of rear *B. rotundiformis* in 14-15‰ salinity revealed that it could be successfully reared with the same efficiency in lower salinity ranges, as well. Experiments are being carried out to estimate the proximate composition of *Brachionus rotundiformis*.

Experiments were initiated for the mass culture of *Moina micrura* at 14-15‰ salinity in translucent circular containers, with 8 litre water of 14-15‰ salinity. They were fed with mixed diatom culture of *Isochrysis* and *Chlorella*. An average of 8500 nos of *M. micrura* were harvested once in 5 days continuously for 6 months from 8 litres of rearing medium.

BROODSTOCK DEVELOPMENT, SEED PRODUCTION, FARMING AND SEARANCHING OF COMMERCIALLY IMPORTANT SPINY AND SAND LOBSTERS (CF/CUL/1.10)

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A recirculating larval culture system was developed for culture of phyllosoma larvae at Calicut. A 500 l cylindro-conical FRP tank was fitted with an upwelling system. Filtered sea water was recirculated through the system. *Panulirus homarus* breeder collected from the sea was brought to the laboratory and maintained under controlled conditions. Active phyllosoma larvae obtained from the spawner were reared in the recirculating larval raring tank. Larvae metamorphosed to second stage on 7th and 8th day and stage 5 on 45th day. Broodstock development of the spiny lobster *P. homarus* was initiated. Three berried females were obtained. Studies on fecundity, egg quality and hatchability of eggs from the captive broodstock were made to compare the results with berried females from the wild.

At Veraval, breeding experiments were initiated on *P. polyphagus*. In the initial experiments success was obtained to rear the larvae upto second stage. Phyllosoma larvae reared in hapas floated in a biofiltration system were healthier and active. At Tuticorin one berried specimen of *P. homarus* released 94,600 phyllosoma larvae.

34 specimens of *P. homarus* measuring an average of 49.6 mm CL and 108 g weight were stocked in a 2 t FRP tank. In another tank of similar dimension 15 lobsters measuring an average of 59.5 mm CL and weight 184.7 g were stocked. The moulting frequency and growth rate were regularly recorded. Lobsters were fed daily with mussels (5-7% body weight). The environmental parameters were recorded daily. After 5 months, the average weight of lobsters in the first tank was 216.5 g, registering a growth of 108.5 g. The lobsters in the second Tank weighed an average of 316.5 g, registering growth of 131.9 g. Fattening experiments showed that lobsters weighing an average of 75 g can be fattened to above 100 g in less

***Panulirus polyphagus* used in the experiments at Veraval**

than 30 days. Lobsters below 100 g were sold at Rs.50/- per kg and thereof 100-200 g for Rs.250-300/-. It is profitable to fatten marginal lobsters of lower grade to the next higher grade to fetch higher price. Similarly lobsters weighing an average 175 g can be fattened to above 200 g in 35 days. Lobsters weighing above 200 g fetch Rs. 400-450/- per kg. An estimated 30 t of live juvenile lobsters weighing less than 100 g are exported from India annually. This needs to be banned.

Growth studies were also carried out on captive *Panulirus polyphagus*. Different sizes were stocked at varying densities (3-4 gms/l and 5-6 gms/l). Juveniles exhibited gregarious co-habitation more than the sub-adults and larger ones. Initially females showed faster growth; but after reaching maturity, males showed faster growth.

MARICULTURE OF CRABS (CF/CUL/1.11)

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At Mandapam, experiments on the F_3 generation of *P.pelagicus* were continued and F_4 generation was produced from them. Three males and two females from the F_3 generation were reared under controlled conditions. One of the females of 182 days old (145 mm/150 g) moulted and successfully mated under captive conditions releasing 3.45 lakh zoeae. From these zoeae 333 baby crabs of F_4 generation were obtained. The same female layed eggs on four subsequent occasions. From these zoeae 1203 baby crabs of F_4 generation were also produced. 333 baby crabs of F_4 generation were further maintained under controlled conditions. After 81 days, they have grown to an average size of 104 mm/75 g and 108 mm/72.5 g for males and females respectively. One of the female of F_4 generation at the age of 150 days, matured, moulted and mated under laboratory conditions and released 2 lakh zoeae. Thus F_1 generation of baby crabs of *P.pelagicus* produced in January 1996 were successfully maintained under controlled conditions and grown upto F_4 generation and the experiments were terminated in December 1998.

Two larval rearing experiments were carried out on *Scylla tranquebarica*. *Brachionus rotundiformis* (S-type) imported from Thailand was used for larval rearing. Two lakh zoeae were stocked in 5 t capacity larval rearing tanks. Larvae were successfully reared upto 5th zoeal stage with 50% survival. In the second experiment 42% survival was obtained from zoea I to zoea IV and 75.7% survival from zoea I to zoeae III. Feeding experiments on the zoeae of *P. pelagicus* and *S. tranquebarica* revealed that they need feed of less than 40 μ size.

Experiments on the broodstock development and larval rearing of *Scylla tranquebarica* at Tuticorin are in progress.

Initial experiments carried out at Narakkal on the reproductive biology of *Scylla tranquebarica* gave encouraging results. An experiment for determining the role of 5-HT was undertaken and successfully completed. Female crabs nearing first maturity were selected and reared to average size of first maturity in a cage maintained in an earthen pond at Narakkal. After they reached first maturity they were injected with 5-HT over a programmed schedule and then reared upto 30 days. Results obtained showed high activity of 17B steroid dehydrogenase in the hepatopancreas of crabs injected with 5-HT. The external morphological characters of crab also were indicative of developing ovaries in the injected crabs and clearly indicated the effect of 5-HT on promoting 17B steroid dehydrogenese activity in the hepatopancreas and enhancement of maturation.

Experiments are continued for the development of an efficient feed for enhancing growth in crabs and shrimps making use of locally available feed ingredients.

S. tranquebarica cultured in cages and pens at Narakkal showed that pen culture was better for growout culture while cages were better for fattening.

During the period under report, crab farming/fattening technologies have been imparted to the farmers at Panambukad. 20 farms (20 to 50 cents) belonging to the scheduled caste families have been selected. Ponds were stocked with 400-450 crabs of 150-200 g size. Regular water exchange was done. They were fed with trash fish @ 10% of their body weight. Growth of the stocked crabs was regularly monitored. They attained a growth of 800 to 850 g in 5-6 months and the production from 20 to 50 cent farms varied from 200 to 250 kgs. The salinity during the culture period varied from 0 to 10.5 ppt.

INTENSIVE CULTURE OF BRINE SHRIMP (CF/CUL/1.12)

M. Rajamani and S. Lakshmi Pillai

During the period under report, experiments were carried out to compare the production potential of the exotic species of brine shrimp *Artemia franciscana* with that of the native species *A. parthenogenetica*. Experiments were carried out in one ton cement tanks and the animals were fed with rice bran. *A. franciscana* collected from a salinity of 120‰ was maintained at a salinity of 35‰. Duration of the experiment was for three months and sampling of the stock population was carried out on five occasions.

In these samples, the percentage of nauplii ranged from 25-50%, juveniles from 33.3 to 50% and adults 12.5% to 66.6%.

A survey was carried out at five stations around Tuticorin to study the distribution of the native and exotic species and the composition of various stages in relation to the prevailing conditions. At Karapad and Veppalodai *A. franciscana* alone was present in the collections and the size range of females was 6.02 - 9.1 mm and 7.2 - 11.2 mm respectively. Only *A. parthenogenetica* was available at Alankarathattu and Tuticorin salt and Marine chemicals Ltd. and the average size of females from these centres was 10.3 mm and 9.3 mm respectively.

V. MOLLUSCAN FISHERIES DIVISION

INVESTIGATIONS ON THE RESOURCE CHARACTERISTICS OF CEPHALOPODS (MF/RE/1)

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Trawl was the chief gear for cephalopods at all the Centres except at Vizhinjam; bulk of the catch at this centre was taken by hook & line followed by boatseines.

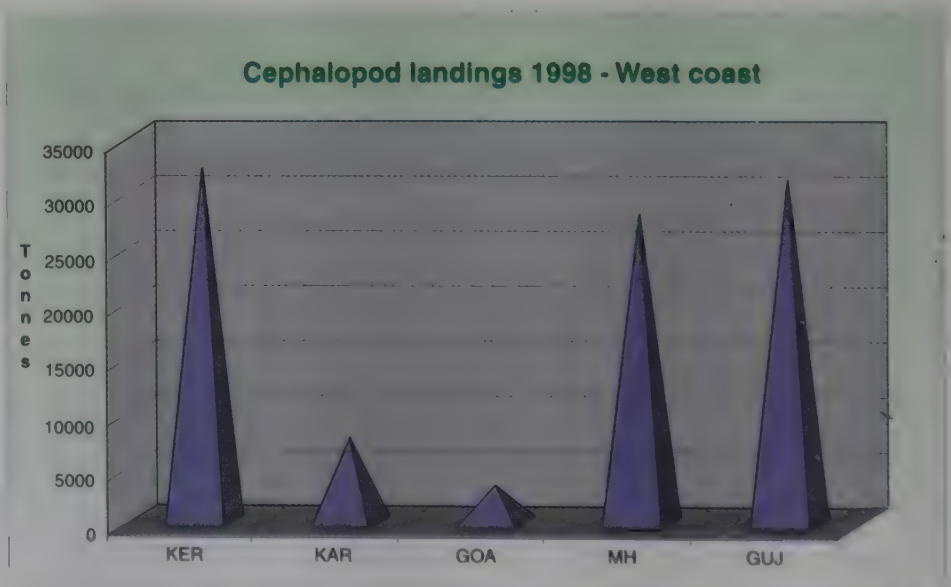
When compared to the production in 1997, there was decline along all west coast centres, but there was increase along east coast centres.

Squids were dominant in the cephalopod landings along west coast (47-78%) and Chennai (52%) along east coast but cuttlefish was dominant (47-68%) along other east coast centres. The estimated landing of *Octopus* was 31 t at Mumbai, 92 t at Mangalore, 116 t at Kozhikode, 91 t at Mandapam, 233 t at Rameswaram and 49 t at Madras.

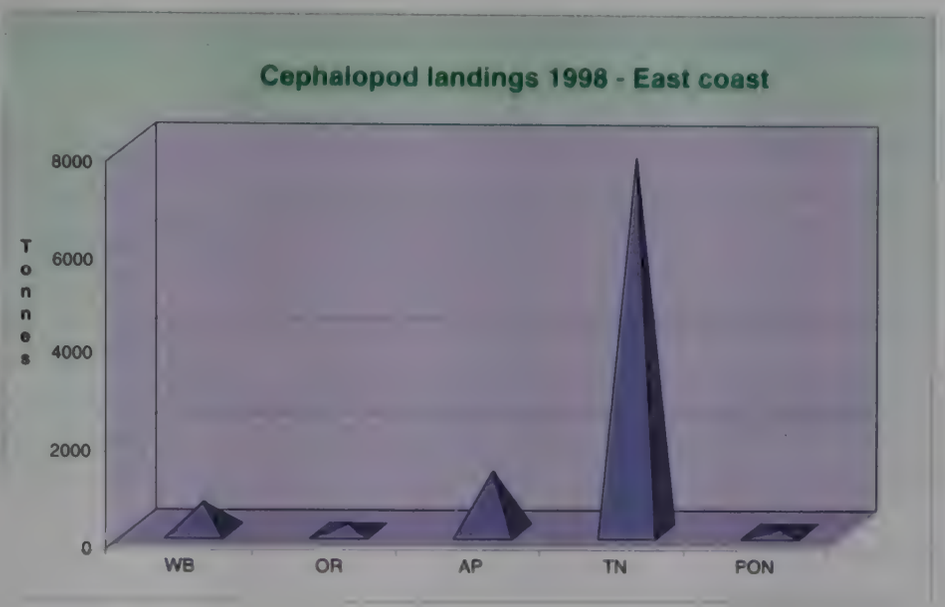
The entire squid landing along north-west coast, north canara coast, Kozhikode and Visakhapatnam was constituted by *Loligo duvauceli*. *Doryteuthis sibogae* occurred in small quantities in the landings at Mangalore, Malpe, Vizhinjam, Chennai and Kakinada. *Sepioteuthis lessoniana* formed 85% of squid landing at Mandapam and 72% at Rameswaram.

Sepia pharaonis and *S. aculeata* were the dominant species all along the coast. *Sepiella inermis* was also observed all along the coast. *Sepia elliptica* was caught along Gujarat and Kerala coasts. *S. prashadi* occurred in good quantities at Mangalore (268 t), Malpe (111 t) and in stray numbers at Chennai (6 t). *S. brevimana* was recorded only at Chennai and Kakinada.

At Veraval, Mangalore, Malpe and Vizhinjam mature squids were dominant almost throughout the year. Juvenile were recorded at Mumbai throughout the year. Peak breeding was observed during September-October off Kochi, whereas it was



during November off Kozhikode. At other centres, mature squids were observed throughout the year but they formed less than 50%.



At Veraval, mature females of *Sepia aculeata* were observed during January, April and December. At Visakhapatnam mature cuttlefishes were dominant whereas at Kakinada immature ones were dominant. At Madras mature males and females were observed through out the year.

Cephalopod landings at different centres in 1998

Centre	Squids	Cuttle fishes	*Octopus*	Total	C/E	% AF
Veraval	1821	1365	-	3186	45	5
Mangrol	494	363	-	857	42	5
Mumbai NFW	3882	2848	23	6753	242	15
Mumbai SD	5999	3735	8	9742	340	19
Karwar	232	113	-	345	-	-
Tadri	218	86	-	304	-	-
Mangalore	2141	1983	44	4168	123	14
Malpe	1533	1306	48	2887	120	13
Kozhikode	420	363	116	899	4	13
Kochi CFH	NA	NA	NA	3647	155	22
Vypeen	NA	NA	NA	942	37	8
Neendakara	NA	NA	NA	5206	77	13
Sakthikulangara	NA	NA	NA	5355	90	14
Mandapam	120	207	91	418	12	6
Rameswaram	315	492	233	1040	14	4
Chennai	1045	932	49	2026	38	6
Kakinada	277	352	-	629	10	2
Visakhapatnam	106	229	-	335	4	4
Vizhinjam	372	103	-	475	-	-

C/E : Catch per unit (trawler day) in kg ; % AF : % in all fish landings; NA: Not available

INVESTIGATIONS ON THE RESOURCE CHARACTERISTICS OF BIVALVES AND GASTROPODS (MF/RE/2)

P.S. Kuriakose, Sujitha Thomas, M.K. Anil, T.S. Velayudhan, V.K. Pillai, V. Kripa, P. Laxmilatha, N. Ramachandran, K. Ramadoss, Boby Ignacious, P.V. Sreenivasan, R. Sarvesan, K.S. Rao, Shoji Joseph and Geeta Sasikumar

The production of mussel was estimated as 3697 t, oysters 492t, clam 38118 t and gastropods 990t.

Mussel

Along the Malabar coast, spawning started in August and spat settlement commenced in September. Good spat settlement was noticed throughout the coast during this year. A survey to assess the availability of mussel seed along the coastal region from Quilon to Chavakad was conducted.

Edible oyster

Oyster exploitation in Navabander creek (Gujarat), was monitored during the year. *C. gryphoides*, *C. rivularis* and *Saccostrea cucullata* were observed in this creek. About 20-22 oysters per sq. m were observed towards the freshwater side and large number of dead ones were observed in the area where the salinity was 21 ppt. Towards the bar mouth, about 140-145 oysters/sq.m were observed; the salinity was 34 ppt in this area.

The length range of *C. gryphoides* during September-December was 60-94 mm with the average of 75.8 mm. Average weight was about 74.2 g and average meat weight 3.36 g and dry flesh weight 0.72 g.

Pearl oyster

A record collection (15 lakhs) of pearl oyster from the 'paars' off Tuticorin was obtained during the year. This revival of the pearl oyster fishery took place nearly after three decades. The nearest paar 'karal paar' was located at 12 m depth. About 900 pearl oysters were fished from 1 sq m area by *SCUBA* diving.

Clam

During the year an estimated 34322 t of *Villorita cyprinoides* were fished from Vembanad lake. The main spawning period was during April-May. *Paphia malabarica* was fished from February to September in Ashtamudi lake with a total landing of 2450 tonnes. About 54% of the total landing was during the month of March. At Chettuva, 163 tonnes of *M. casta* was landed during January-April and August-September. The size ranged from 14 to 30 mm.

Near the bar mouth of the Navibander creek, 150-300 individuals per square meter *Meretrix* sp were found. The dorso ventral length range was 24-33 mm with a shell-on weight ranging from 14 to 27 g. Average raw flesh weight was 1.56 g and dry flesh weight 0.35 g. However, there was no fishery for this

resource in the creek.

Gastropods

222 chanks (*X. pyrum*) were tagged and released at Kovalam, Vizhinjam. During the year, 12 egg capsules were obtained. The laboratory reared chanks attained growth of 23.68 mm from 8.6 mm (MSD) in 6 months. 270 chanks including juveniles and adults are reared in the laboroatory at Mandapam with flowthrough water system.

In Dhamlej, Sutrapada and Hirakot near Veraval, *Tibia* sp is landed in bulk as bycatch

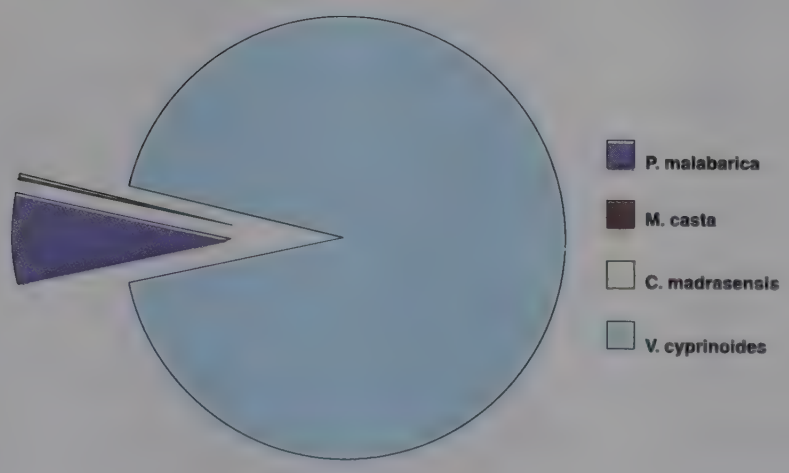
Estimated production of Bivalves & Gastropods at selected centres during 1998

Species	Location	Production (t)	Remarks
MUSSEL	**BIVALUES**		
P. viridis	Malabar coast Chaliyam to Koduvally	3148	C/E 49 kg/man-day
	Madras (Ennore estuary)	72	40-98 mm size range
	Karwar	73	41-98 mm size range
P. indica	Southwest coast (Trivandrum to Colachel)	404	19.2 kg/man-day
Total		3697	
OYSTER			
Crassostrea madrasensis	Karwar	14.75	-
Saccostrea cucullata	Karwar	83.7	-
C. madrasensis	Quilon (Ashtamudi lake)	56	Peak spawning April-June
C. madrasensis	Madras (Ennore estuary)	322	5-6% meat content
C. madrasensis	Kakinada	15.2	June-July peak landings
Total		491.7	
CLAMS			
Paphia malabarica	Karwar	143	-
M. meretrix	Karwar	134	-
M. casta	Mangalore	54	58% hand picking
V. cyprionoides	Cochin(Vembanad lake)	34322	April-May peak spawning
Paphia malabarica	Quilon (Ashtamudi lake)	2450	Peak landing March
M. casta	Ennore, (Madras)	110	April peak landing
M. casta	Chettuva estuary	163	14-30 mm size range
A. granosa	Kakinada	742	-
Total		381181	

GASTROPODS

Xancus pyrum	Tuticorin	1518050 Nos	125 days fishing
Ficus sp	Madras	5	
Babylonia sp	Madras	9.7	
Hemifusus	Madras & Kakinada	100.3	
Bursa sp	Madras & Kakinada	80.5	
Cerethidea sp	Kakinada	330	
Umbonium sp	Kakinada	30	
Thias sp	Kakinada	11.5	
Telescopium sp	Kakinada	5	
Others	Kakinada & Madras	217.5	
Total		789.5	

Estimated production of bivalves 1998



of lobster fishery from the reefs in gillnet fishing. The length ranged from 100 to 143 mm and the shell-on weight from 34 to 137.3 g. The shells are exploited for ornamental use.

At Tuticorin , one tagged chank released in 1992 was recaptured in July 1998. The length and weight difference was 8.9 mm and 78 g respectively. Though licenses for chank fishing were not issued due to poor clarity, the chank exploitation was carried out off Tuticorin.

SEED PRODUCTION AND RANCHING OF BIVALVE MOLLUSCS IN COASTAL WATERS (MF/CUL/4)

K.K. Appukuttan, A. Chellam, S. Dharmaraj, K. Ramadoss, D. Sivalingam, P. Muthiah, G.P.K. Achary and P. Laxmilatha

In view of the stringent quality standards of the EEC for farmed shrimps, an experiment was conducted at Cherai, Cochin by transplanting clams in shrimp farm-effluent reservoirs to test the feasibility of treating the effluent water through biofiltration by bivalves before discharging into the sea.

A reservoir collecting the effluent water drained from a shrimp pond was selected. About 250 kg at 500 No/sq m of the black clam, *Villorita cyprinoides* was stocked on 18.8.98. The water, soil and bacteriological parameters were monitored every fortnight, both in the shrimp pond and reservoir. However, due to incessant rains for a week during October, there was drastic fall in the salinity and all the clams died. This experiment will be continued incorporating mussels and oysters also to be able to identify the most efficient biofilters.

Polyculture of shrimps and green mussel: M/s.Tata Chemicals Limited, Gujarat made an attempt to culture green mussel in shrimp ponds. 100 kg of mussel seed were transported to Gujarat with assistance from Karwar RC of CMFRI and transplanted in the shrimp ponds. The objective was to establish the dual purpose of enhancing production through two crops ie shrimps and mussels, besides testing the biofiltration capacity of the mussels to reduce the level of suspended solids. In 81 days of culture, the average growth of 49.1 mm and average shell on weight of 9.48 g and meat conversion of 44% were obtained. An yield of 100-120 kg gross weight is expected by April end. Similarly a private farmer has also successfully cultured mussels in shrimp ponds in Goa.

Tuticorin: During the year, a total of 16 induced spawning and rearing experiments were conducted out of this, 6 experiments were successfully reared upto setting stage. Other experiments were discarded due to various reasons. A total of 2,32,220 edible oyster spat were produced in the hatchery and sent for further culture. A total of 2.62 lakhs of pearl oyster seeds were produced in the hatchery, out of which 50,000 seed were supplied to the Regional centre of CMFRI, Mandapam, along with 12.3 million veliger larvae.

TECHNOLOGICAL FEASIBILITY OF BIVALVE CULTURE AT SELECTED CENTRES (MF/CUL/8)

G. Syda Rao, E.M. Abdussamad, R. Sarvesan, P. Natarajan, P.V. Sreenivasan, K. Ramadoss, M.K. Anil, Geeta Sasikumar and P.K. Krishnakumar

Karwar: The feasibility of pen culture of the clam, *Gelonia* sp at Harwadan was initiated in early 1998. Growth, survival and environmental parameters were monitored at regular intervals.

The long-line mussel culture programme, initiated in 1988, in Belambar area wth the involvement of a Fishermen co-operative society was terminated due to heavy infestation by barnacles causing slippage of mussels, poaching of mussel ropes besides heavy cyclonic winds. Thus Belambar area was found unsuitable for mussel culture.

In order to study the possibility of mussel culture in prawn culture ponds, a batch of six farmers from Goa were involved in a training programme on mussel culture at Karwar Research Centre during December 98. A long-line of 20 m with 16 floats and 15 seeded ropes were installed in Karwar Bay for further farming.

Mangalore: The experiment on mussel culture in the Mulky estuary revealed the unsuitability of the region during monsoon months, due to drastic fall in salinity causing the mussels to drop off.

About 1.5 t of mussel, cultured in the earlier experiment in the Mulky estuary was harvested in June during a "Mussel harvest Mela".

During May 98, a successful attempt was made to transport 100 kg live mussels to Goa to assess the market response. The mortality rate was found to be 25% in 24 hrs during the transport. However, the mussels fetched only low price in Goa, whereas the response in the local market at Mangalore was good for shell-on mussels.

Visakhapatnam: A survey on the distribution of edible oyster, *Crassostrea madrasensis* indicated the patchy distribution of a few oyster beds in the estuarine areas. The spat settlement studies indicated that *C. madrasensis* showed good settlement in July and August period. The samples obtained by the end of September ranged from 10 - 15 mm in size which attained 30-40 mm at the end of December, 98. The edible oyster bed distributed in the estuarine area of Bhimili is being utilised for studying the feasibility of oyster culture.

Tuticorin: Punnakayal area was selected for testing technological feasibility of clam culture. Initially in the month of May a batch of about 1500 clam seed was transplanted at the predetermined area along with 100 numbers of shell cultches with spat of edible oyster and the growth and survival were monitored. The edible oysters survived in the area to the extent of 100% and also registered

good growth. The clam seed could not be traced in the following months due to total mortality. Another batch, consisting of 250 numbers of pearl oysters of the size range 35-40 mm collected from the wild was transplanted at Punnakayal estuary in velon screen bags in the month of September. Data on growth and the environmental conditions were collected.

Madras: Since March 1998, clam seed of *Meretrix casta* were transplanted repeatedly in the culture site at Pulicat in an attempt to establish a new clam bed and this encouraging results. Growth and survival of the transplanted clam seed were monitored. Observations on the condition of gonads indicated that spent individuals were more common among both males and females. Ripe and maturing stages were found in equal numbers. Regular data on the environmental parametres were obtained to study the hydrological conditions prevailing in the culture site.

EDIBLE OYSTER CULTURE (MF/CUL/9)

P. Muthiah and K. Ramadoss

At Tuticorin 272 strings with spat set on shells were transferrred from the hatchery to farm. 82.75 kg of oyster meat was sold fetching Rs.4112.50 and 5 kg of oyster meat was used for demonstrations.

UPGRADATION AND TRANSFER OF TECHNOLOGY OF PEARL CULTURE (MF/CUL/10)

A.C.C. Victor, I. Jagadis, Boby Ignatius, A. Chellam and S. Dharmaraj

Maintenance and Management of pearl oyster farm and pearl oysters: The stock in pearl oyster farm at the Mandapam Regional Centre was replenished with oysters collected from the wild. A total of 20 sea trips were made to the natural pearl oyster beds off Tuticorin and 5.53 lakhs of oysters of the size range 20-46 mm DVM were collected by *SCUBA* diving

Pearl oyster farm at Mandapam Camp

and transported by road to Mandapam Camp and stocked in the farm in different types of culture containers. The farm was also stocked with hatchery produced spat (5-22 mm DVM). The total stock of pearl oysters at the farm is presently 0.85 million.

Spawning, larval rearing and spat production: A total of 23 successful spawnings occurred in the hatchery and a total of 56 lakhs straight hinge veliger larvae were obtained, of which 3.67 lakhs of spat (1-6.0 mm) were raised and transported to the farm for nursery rearing.

Nucleus implantation and pearl production: A total of 43,798 oysters were operated and implanted with nucleus of 8 mm dia (35,606 nos) 4 mm dia (8,157 nos) and 5 mm dia (35 nos). These oysters are reared in the farm for pearl production.

The seperated oysters were harvested for pearl after a period of 9-10 months post operative culture. Out of the 5831 nucleated oysters, only 2774 (47.6%) oysters were found alive at the time of harvest and on harvest, these oysters yielded 448 pearls of various quality viz. A grade-56, B grade-74 and C grade-318.

Implantation of nuclei in progress for pearl production at Mandapam

POPULARISATION AND TRANSFER OF BIVALVE CULTURE TECHNOLOGY AT SELECTED CENTRES ALONG KERALA COAST (MF/CUL/11)

K.K. Appukuttan, T.S. Velayudhan, V. Kripa, K.S. Mohamed, P. Laxmilatha, P.S. Kuriakose, N. Ramachandran and V. Chandrika

Ashtamudi Lake (Dalavapuram, Quilon): Experiments were carried out to upgrade the technology of edible oyster culture. The feasibility of culturing oysters by cementing individual oysters onto split bamboo poles was initiated during April. The main objective was to grow large size uniformly shaped oysters so as to market it in live condition and shell-on (half-shell), which are in high demand in metro cities and highly priced in the export market.

Oysters of length 35 to 85 mm were collected from natural bed, declumped, cleaned, measured and cemented onto split bamboo pieces (1.5 m length, 5 cm width). To ensure proper fixing, iron nails were driven at intervals of 10 cm into the bamboo pole before placing the cement and fixing the oysters on it. After curing for 6 hrs, the bamboo strips with oysters were hung horizontally from the rack. Small-sized oysters of length 15 to 25 mm were stuck using "Fewikwik instant" to test the efficacy of the adhesive. They were also hung from the same rack.

The growth and survival of the cemented oysters were recorded. The survival percentage after 35 days was 69%, loss due to detachment 19%, loss due to natural mortality 12%.

The growth rate of oysters grown by the ren method were also monitored. Growth of two different recruits of oysters i) oyster spat settled in March 1997 and ii) oyster spat settled in December 1997 were monitored. It was observed that large size oysters of length 128 mm total weight 175 g and meat weight 17.5 g can be obtained if the duration of the cultured period is extended to 14-15 months. However, even small oysters were noted in the rens indicating the wide variation of oyster size composition in rens.

Oyster Harvest: The oysters grown in the CMFRI demonstration farm at Dalavapuram, Quilon were harvested and sold for Rs.3700. This was obtained from the sale of 74 kg of heat shucked oyster meat to the Institute staff at a subsidised rate of Rs.50/kg. Technical guidance was given to Shri Vincent Mukadan, an oyster farmer, to harvest the oyster produced in his farm. Efforts were also made to sell the oyster meat in the local markets and IFP. In this regard, Rs.25,292 realised from the sale of 404.5 kg oyster meat was handed over to Shri V. Mukadan.

Maintenance/renovation of farm: The demonstration oyster farm was reconstructed by replacing the old broken bamboos. However, in view of its short life, due to boring/fouling, an attempt was made to renovate the structure by replacing the bamboo poles with PVC pipes of 2" dia and 2.5 m length, filled with concrete. Oyster rens were suspended from these poles. The results are encouraging, since there is less fouling/ boring and therefore more durable and permanent.

Mussel farming: Green mussel (the average length was 21.6 mm and weight 1.0 g) collected from Thankassery near Port Quilon, were seeded on 20 ropes of 1 m length nylon rope and 1 rope with brown mussel were seeded and suspended from the grow out structure. Mussel seed collected from Narakkal were also used, however they lost due to slipping.

Transplantation of the Corbiculid clam : About 50 clams (*Geloina bengalensis)* which were reared at Fisheries Harbour Laboratory were transplanted in, August, 1998, in Ashtamudi Lake for accelerating gonad maturation. After taking length and weight

measurements they were stocked in netlon cages. The cages were kept just above the estuarine substratum. Growth and survival of these clams were monitored regularly.

Narakkal (Mussel culture-raft method)

Demonstration: Open sea mussel culture was initiated at Narakkal as a demonstration programme with the involvement of four fishermen. The fishermen were trained in fabrication of raft and mussel seeding. The bamboo raft of 25 sq. m (5 x 5 m) was moored off Narakkal at a depth of 4 to 5 m with the help of the fishermen.

For mussel seeding also local women were given a training in October 1998 by KVK, Narakkal and after training the women actively participated in mussel seeding. Mussel seed was collected from the intertidal zone of Narakkal beach. Mussel seed (average length 27.1 mm; breadth 15.6 mm; depth 9.65 mm, total weight 2.45 g; meat wt 0.6 g) were seeded at a density of 1.5 kg/m length of nylon rope. About 58 seeded mussel ropes of 12 mm diameter of length 3 m were seeded and suspended from the raft.

In November due to the twisting of anchor ropes on the seeded ropes due to rough sea condition intense seed slipping was observed. Mussel seed was stocked in nylon bags to reduce labour and time. Initially nylon net tubes of length 1.5 to 2 m were made. In each tube, mussel seed collected from Narakkal were stocked in 5 to 6 pouches seperated by knots tied at equal intervals. The stocking density was 200 g/pouch. 28 net tubes (each with 5 to 6 pouches) were prepared using 33.2 kg of seed. These nylon bags were suspended from the raft in December 1998.

Experiments on seeding density: An experiment to study the effect of seeding density on seed slipping and growth was initiated. Three stocking densities a) 500 g (250 nos) b) 750 g (375 nos and c) 1000 g (500 nos) per meter were tried. After 45 days it was observed that the density of seed in the three trials were 130, 215, and 290 nos/m respectively.

Another experiment to study the growth rate of mussel by direct observation was also started in October 1998. Individual mussels were measured and kept in separate velon screen pouches. Along with this, groups of 10 mussels (replicates) which were measured individually were kept together in separate pouches. The average growth rate will be observed and compared with the first experiment. In December it was noted that there was fresh settlement of mussel seed on the velon screen pouches.

SELECTIVE BREEDING OF BIVALVES AND EVALUATION OF PERFORMANCE BY FARM TRIALS (MF/CUL/12)

T.S. Velayudhan, P.S. Kuriakose, V. Kripa, K.S. Mohamed, P.Laxmilatha and C.P. Gopinathan

Samples from Ezhikara '2' and Nettoor shown highest mean thickness of the shell at 'C' point region 2.627 mm and 1.732 respectively, followed by Ezhikkara '1' and Muhamma '1' 1.79 and 1.291 mm respectively as per samples collected from unfished sites. In the case of "AS" anterior sinus the mean thickness at Ezhikkara '2' 2.331 and Nettoor 1.926 mm observed respectively. The selected areas of the shells thickness shown a decreasing trend 1.303 mm and 1.128 mm, 1.108 mm at Ezhikkara "1" Mohamma '2' and '1' respectively. Regarding 'PS' posterior sinus the highest mean at Ezhikkara '2' 1.845 mm and at Ezhikkara '1' 1.220 mm respectively followed by 1.011 mm at Nettoor respectively, followed by Muhamma '2' 0.959 mm and Muhamma '1' 0.925 mm.

At the outset Ezhikkara '2' shells shown highest mean thickness 2.627 mm at 'C', 2.331 mm a 'AS' and 1.845 mm at 'PS' respectively showing possible thickness for these shells for further study for the left valve of *Villorita cyprinoides*.

While last years collections from Nayarambalam, the mean thickness of the shells at 'C' 7.14 mm and 6.88 mm at "AS" with maximum 9.75 mm and minimum 5.75 mm were noted respectively for the left and right valves of *Villorita cyprinoides*.

CULTURE OF CEPHALOPODS (MF/CUL/13)

D. Sivalingam, Shoji Joseph and M.K. Anil

Breakthrough in rearing of cuttlefish achieved : Laboratory rearing, breeding and larval development of *Sepiella inermis*, was achieved at the Tuticorin Hatchery.

Egg clusters of *S. inermis* collected from Manapad during September, were hatched in the laboratory. Of the 653 hatchlings released, 360 survived upto day 24 and attained a size of 11-18 mm (ML). After 75 days, 51 juveniles survived, with a size range of 57.23 mm (ML) and mean weight of 37.9 g.

These laboratory reared *Sepiella inermis* attained maturity and started egg deposition from the 75th day onwards, and 100% hatching was obtained. The hatching commenced 13 days after egg laying. This is the first time that the life cycle of *S. inermis* was completed in the laboratory. The F1 generation reached a mean size of 16.2 mm (ML) in 31 days. The hatchlings were fed with mysids and *Acetes*.

A total of 12,400 hatchlings of size 6.00

mm, as a result of continous breeding of the laboratory reared S. inermis, were ranched off Hare Island at a depth of 1.3 m.

Hatchling of eggs collected from Periyathalai on 27.4.98, also occurred on 8.5.98. Of the 93 hatchlings released, successive mortality occurred upto day 69. A mean length of 53.56 mm was recorded in 70 days.

Sepioteuthis lessoniana: Egg clusters were collected from Periyathalai and 1240 hatchlings were obtained. Initial mortality was high. On day 68, the juveniles measured a mean size of 58.4 mm (ML), and a mean weight of 22.6 g. Total mortality occurred by August.

SEED PRODUCTION AND PEARL CULTURE IN THE ABALONE *HALIOTIS VARIA* (MF/CUL/14)

A.C.C. Victor, A. Chellam, S. Dharmaraj and Boby Ignatius

Abalones were induced to spawn profusely and the development of larvae was traced. However, settlement did not take place. Different seaweeds such as *Ulva*, *Thalamoporella Hypnea* and *Cymadocea* were given as food, of which *Cymadocea* was found to be most acceptable to the abalones.

STANDARDISATION OF TECHNIQUES IN ONSHORE PEARL CULTURE (MF/CUL/15)

G. Syda Rao, R. Sarvesan, P.V. Sreenivasan, M.M. Meiyappan, T.S. Velayudhan, K.S. Mohamed, K.G. Girijavallabhan, Reeta Jayasankar and K. Vijayakumaran

After a series of experiments in 12 t cement tanks, the technique of captive maturation and breeding of the pearl oyster is standardised at Visakhapatnam. It has been inferred that pearl oysters at low density (about 12 - 15/m) with 100% daily raw sea water exchange, will induce maturation in about 10 weeks. They can be reused for spawning 2-3 times at regular intervals. Good quality pearl oyster broodstock is maintained at two private hatcheries. The first batch of spat, raised from July spawning have reached a mean DVM of 30 mm by December with least mortality. A few pearl oysters were implanted with 3-5 mm nuclei. The first trial batch of pearls are expected in March 1999. With the reconstruction of the hatchery buildings and other infrastructure facilities, both units are expected to reach commercial production by June, 1999. The feed production, species composition and their concentration in the sea water has been standardised. An average concentration of 50,000 cells/ml is being maintained, irrespective of other environmental parameters. Thus, salinity during the year ranged from 18to 35 ppt which has not caused any problem for rearing of pearl oysters or feed (*Chaetoceros calcitrans*, *Isochrysis galbana* and *Nanochloropsis salina*) production.

DEVELOPMENT OF LOW-COST TECHNOLOGY SYSTEM FOR SEAFARMING OF PEARLS AND MUSSELS (MF/CUL/16)

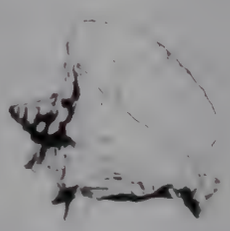
G.P. Kumaraswamy Achary, Rani Mary George, S. Jasmine, M. Sivadas and K. P. Syed Koya

Observations made at Muttom, Colachel, Kadiyapatnam revealed the availability of *Pinctada fucata*, indicating the suitability of these areas for shallow-bottom pearl farming.

A new raft was launched and broodstock of oysters were transferred along with spat collectors and hapa. Good growth was recorded throughout the period of observations. Two new hapas were again introduced in April, with Broodstock of oysters. 35 additional spat collectors were suspended in November.

The fabrication and operation of the high-density-stocking pedestal cages were demonstrated at Tuticorin centre to trainees during 27-29 March and a cage was launched in the open sea at Arokiapuram fishing village and in April, the broodstock of pearl oysters were stocked in the cage. About 10000 Pearl oyster spat collected from the natural beds off Tuticorin were transported to Vizhinjam on 8.10.98. Good survival and growth was observed.

For maintaining and fattening lobsters as a side-crop in the multi-crop system for increased income, the lids of the high density stocking cages were slightly modified for periodic stocking of mussel as feed for the lobsters and it was observed that lobsters of around 150 mm size grew to 180 mm size (8 nos = 1 kg) within one month.



VI . FISHERY ENVIRONMENT MANAGEMENT DIVISION

During the period under report the Division was engaged in a total of 12 Institute research projects and 1 sponsored research project.

BIOLOGICAL PRODUCTIVITY OF THE INDIAN EEZ IN RELATION TO OCEANOGRAPHIC PARAMETERS (FEM/SS/1)

V.N. Pillai, V.K.Pillai and K.G. Girijavallabhan

Environmental data collected onboard FORV *Sagar Sampada* for validation of the Modular Optoelectronic Scanner (MOS) during April 1998 were analysed for the preparation of Algorithm in collaboration with Space Application Centre, Ahmedabad. Averages for various parameters such as seawater temperature, salinity, dissolved oxygen, nutrients, chlorophyll and zooplankton were arrived at by pooling of seatruth data collected by the erstwhile FAO/UNDP Pelagic Fisheries Project (1971-78), *Cadalmin* series of vessels (1980-1998) and FORV *Sagar Sampada* (1990-1998) for the southeastern Arabian Sea region. The project undertaken in collaboration with the Space Application Centre aims at the utilisation of surface chlorophyll data obtained from satellite imageries (IRS P3 and OCEANSAT) for the preparation of PFZ advisories along with SST data in view of it's proven relationship with herbivores like oilsardine, which exhibit wide fluctuations in their occurrence as well as abundance from year to year.

INVESTIGATIONS ON ENVIRONMENTAL PARAMETERS OF INSHORE WATERS IN RELATION TO FISHERIES (FEM/ES/1)

C.P. Gopinathan, V. Chandrika, S. Muthusamy, T.S. Naomi, V.V. Singh, P.K.Krishnakumar, S.Krishna Pillai, M. Rajagopalan, K. Vijayakumaran and P.T. Sarada

The studies on the environmental parameters of inshore waters in relation to fisheries were continued at Cochin, Vizhinjam, Mangalore, Karwar, Mumbai, Minicoy, Kakinada, Mandapam, Tuticorin and Visakhapatnam. The salient features are given in the following table:

Ranges of Fishery Environmental Parameters at different Centres along Indian Coast-1998

Centre	SST		Diss. Oxygen		Salinity		Nitrites		Nitrates		Phosphats		Silicates		Prim. Produ.		Zoopl.biomass	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
	°C		(ml/l)		(ppt)		(µg at/l)		(µg at/l)		(µg at/l)		(µg at/l)		(mg C/m^3/day)		(ml/m^3)	
Cochin	23.5	32.5	3.03	4.96	24.5	35.08	0.24	1.56	0.0	3.96	0.24	3.77	0.8	33.79	173	1557	0.00	1.81
	Sept	Apr.	Sept.	Mar.	Sept.	Mar.	Feb.	Apr.		Sept.	Feb	Dec.	Apr.	Sept.	(mon-	pre-		
															soon)	monsoon)		
Mangalore	27.5	32.5	1.89	4.29	23.80	34.20	0.07	1.80	-	-	1.8	8.70	-	-	42	48	3.00	9.0
Karwar	25.8	31.7	3.73	4.67	10.64	30.89	-	-	-	-	-	-	-	-	161	648		
Mumbai	26.0	34.0	2.29	7.08	9.04	37.12	0.00	14.29	0.0	19.36	0.61	8.21	0.0	103.1	0.0	1219	-	-
Minicoy	26.4	30.9	2.00	7.00	30.60	34.20	0.51	2.04	1.0	2.28	0.69	2.08	0.52	3.05	0.00	436	4.0	7.5
Kaki nada	29.0	31.5	3.92	4.83	12.65	35.18	-	-	-	-	-	-	-	-	-	-	-	-
Manda pam	27.0	33.0	3.57	5.49	26.45	33.62	0.50	4.38	0.69	12.19	0.11	0.50	5.2	21.98	236	1870	3.83	6.77
Visakha patnam	23.9	28.9	3.40	7.15	21.08	35.41	0.00	0.19	-	-	0.08	0.92	0.56	1.96	-	-	-	-
Tuticorin	24.9	28.0	2.31	4.13	31.07	33.86	0.04	0.78	-	-	0.34	3.03	2.1	16.3	87.0	225	3	5
Vizhinjam	26.6	27.8	4.05	5.70	33.75	35.09	-	-	-	-	-	-	-	-	-	-	0.5	7.5

ECOLOGICAL INVESTIGATIONS ON THE INTERTIDAL AND SURF ZONES OF THE KERALA AND KANYAKUMARI COASTS IN RELATION TO FINFISH AND SHELLFISH SEED AND JUVENILE RESOURCES (FEM/ES/6)

G.S. Daniel Selvaraj, Molly Varghese, S.Krishna Pillai and S. Jasmine

During the year, monthly surveys were carried out at Kozhikode, Kochi, Vizhinjam and Kanyakumari along the surf regions and adjoining estuarine systems to collect data on water temperature, salinity, dissolved oxygen, nutrients and primary productivity. Information on fish and prawn juveniles was also collected from the local landing centres. The values of phosphate, nitrite and nitrate were high around Kochi and the highest values were recorded during June-July. The primary productivity was high towards Kozhikode in the surf zone and in the backwater zone. The availability of juveniles of fishes was less than the previous year. Juveniles of *M.dobsoni* were common in all the Centres throughout the year, and those of *P.indicus*, *M.monoceros* and nonpenaeids showed decline during 1998.

Investigations were also carried out in the mangrove area of 'Mangalavanam'(Cochin) during the year. Dissolved oxygen values were less than 2.5 ml/l during the south-west

Monthly hydrographic data for the surf region at Cochin during 1998
(average of Kannamaly, Manassery and Fort Cochin stations values)

Months	Surface temp.(°C)	Salinity (ppt)	Diss.Oxygen (ml/l)	Nutrients (µg at/l) Phosphate	Nitrite	Nitrate	NetPrim.product. (gc/m³/d)
January	30.3	33.2	4.36	0.70	0.66	0.68	0.054
February	30.4	33.1	3.88	1.13	0.64	1.20	1.207
March	31.7	31.1	3.88	1.16	0.26	0.93	0.188
April	31.8	34.3	3.71	0.94	1.70	0.32	0.060
May	31.0	30.3	3.71	2.51	1.49	1.04	0.509
June	26.6	19.5	3.97	3.12	0.83	1.10	0.902
July	26.3	23.2	3.57	3.35	3.15	0.0	0.121
August	29.5	18.3	4.49	2.34	0.92	4.13	0.156
September	27.5	22.4	2.99	2.61	1.63	3.75	0.414
October	28.2	26.7	2.96	3.57	1.12	7.14	0.582
November	29.3	29.3	3.13	0.86	0.33	1.34	0.297
December	29.0	31.0	3.08	2.14	0.68	0.20	0.068

Quarter-wise hydrographic data for the surf region of the sea at Cochin during January-December 1998

Months	Surface temp.(°C)	Salinity (ppt)	Diss.Oxygen (ml/l)	Nutrients (µg at/l) Phosphate	Nitrite	Nitrate	Net Prim. Product (gc/m³/d)
I Qr.	30.8	32.5	4.04	1.00	0.52	0.94	0.483
II Qr.	29.8	28.0	3.80	2.19	1.34	0.82	0.490
III Qr.	27.8	21.3	3.68	2.77	1.90	2.63	0.230
IV Qr.	28.8	29.0	3.06	2.19	0.71	2.89	0.316

and postmonsoon months while the adjacent Cochin backwater showed average values of more than 3.5 ml/l. The rate of photosynthetic production of oxygen was found not enough to cope up the loss of oxygen by algal respiration and bacterial action in the 'Mangalavanam' waters indicating that the 'Mangalavanam' does not provide a self replenishing environment for the healthy survival of aerobic organisms.

SEAWEED INVESTIGATION: RESOURCES ASSESSMENT OF SEAWEEDS AND THEIR CULTURE (FEM/SW/1)

V.S.K. Chennubhotla, N. Kaliaperumal, Reeta Jayasankar and Gulshad Mohammed

The agarophyte *Gracilaria edulis* cultured in the main laboratory at Visakhapatnam in fibre glass tanks showed a 3-fold increase in weight. The culture of *Gracilaria verucosa* and *G.corticata* also showed good growth.

Experiments were conducted at Mandapam with *G.edulis* by penetrating the seed material with 0.2 mg/l concentration of Inositol and further treatment of seed material with same concentration of Insitol for 12 hrs at different intervals. Control experiment was also maintained. Maximum increase in bio-mass (36%) was obtained in plants treated at intervals of 3-6 days.

G. edulis collected from Hare Island was grown in fibreglass tanks at Tuticorin. The initial weight was 2.8 kg. The average length of the plants was 16.6 cm. Due to the growth of epiphytic algae *Chaetomorpha antennina*, there was not much growth. The plants weighed 3.2 kg and measured 18.6 cm long after 29 days.

A 12-fold increase of weight of *Acanthophora specifera* was obtained in 70 days culture in Minicoy lagoon. Ropes on remnents of seed material of this species were introduced for culture and after 42 days a maximum of 36-fold increase was obtained and minimum of 30.1 fold increase in 36 days.

MONITORING THE STATE OF HEALTH OF COASTAL WATERS IN RELATION TO POLLUTION AND AQUACULTURE (FEM/MP/1)

V.K. Pillai, P. Krishnakumar, M. Rajagopalan, P. Kaladharan, D.C.V. Easterson, N.S. Asha and S. Krishna Pillai

Cochin

Regular environmental monitoring was carried out in the inshore areas of Cochin. Data on temperature, dissolved oxygen, and nutrients were collected at surface and bottom from four stations. No significant variations were noticed during the period. Analysis of sediments revealed an increasing trend in selected metals especially in the in-shore area during November and December 1998.

An instance of large scale fish kill in Chithrapuzha, Cochin estuary during July 1998 was investigated jointly by the Scientists of CMFRI and CIFT and the report was submitted to the District Collector, Ernakulam as required by the Govt. of Kerala. The investigations revealed that high levels of free Ammonia (up to 102 ppm) in the water which would have originated from the industrial effluents could be the causative factor for the large scale fish mortality.

As part of the pollution monitoring programme, the total humic acid (THA) was estimated in water and sediment. THA levels in water ranged from nil to 9.55 ppm at surface and nil to 9.71 ppm at the bottom. THA is of terrestrial origin and is considered as natural chelator, stimulant of phytoplankton growth and pollution abatement agent.

Environmental monitoring in the Cochin estuarine area was carried out for Cochin Port Trust under the consultancy programme. Regular data on 12 parameters were collected from 4 stations on a fortnightly basis.

Mangalore

The Biochemical Oxygen Demand (BOD), residual chlorine, ammonia, ammoniacal nitrogen, sulphide, cyanide, grease and oil, colour and odour were determined from the sea water samples collected from 3 stations off Chithrapur near the marine outfall of a refinery. Chlorophyll a content and zooplankton biomass were estimated from the marine outfall and compared with such data from a reference site.

The results showed that the mean Ammonia content near the marine outfall was 0.011 mg/l and mean ammonical nitrogen content 0.008 mg/l. Mean BOD residual chlorine and total suspended solids (TSS) near the marine outfall were 0.92 mg/l, 0.051 mg/l and 131.4 mg/l respectively.

Mean zooplankton biomass near the marine outfall was 10.6 ml/m^3 and mean chlorophyll a content was 0.685mg/m^3. Zooplankton biomass and chlorophyll a in seawater and the heavy metal concentration in marine biota in the marine outfall were within the normal range. There was no increase in heavy metal accumulation in marine organisms in the above site from 1996 to 1999.

Oil pollution: During the first week of June '98, weathered crude oil (tarball residues) settled on the beaches of Dakshina Kannada coast, as during the same season of the previous year. During this season, the intensity of tarball settling was less compared to 1997. The origin of the tar residues may be from offshore spillage in and around the major oil tanker routes in the Arabian Sea. During the monsoon season the surface currents in the Arabian Sea are towards the Indian coast. Therefore, with the onset of southwest monsoon, the strong westerly wind and ocean surface current must be carrying lot of tarlike oil residues towards the coast. Observations on the beaches along the west coast of India indicate that tarball deposition occurs between may and October when shorward component of the current is strong.

Comparison of zooplankton biomass at the marine outfall of an oil refinery of Chithrapur, Mangalore with zooplankton biomass at a control site.

Month	Reference site (ml/m^3)	Marine outfall (ml/m^3)
Apr. 98	1.955	1.34
May	4.86	2.69
Oct.	9.46	0.42
Nov.	90.8	16.3
Dec.	16.6	13.3
Jan.99	15.18	5.59
Feb.	14.8	4.96
Mar.	6.4	20.5
Mean	20.0	8.1

Comparison of chlorophyll *a* content in seawater at the marine outfall of an oil refinery off Chithrapur, Mangalore with chlorophyll *a* content at a control site

Month	Reference site (ml/m^3)	Marine outfall (ml/m^3)
Apr. 98	0.298	0.349
May	0.258	0.505
Oct.	0.273	2.218
Nov.	0.281	0.591
Dec.	0.237	0.348
Jan.99	0.247	0.334
Feb.	0.194	0.447
Mar.	0.258	0.331
Mean	0.256	0.640

Tuticorin

Regular pollution monitoring programme at Kayalpatnam and Karapad Bay were carried out. In the Karapad Bay low pH and salinity were recorded during December due to the onset of Northeast monsoon. The recorded pH and salinity values ranged between 3.26 to 7.84 and 20.62% to 37.13‰ respectively. Lowest dissolved oxygen value (1.486 mg/l) was recorded in the open sea during November. At Karapad Bay, turbidity was high (range 4.5 to 78.70) during June & July '98. At Kayalpatnam the water was acidic (pH 2.44) during August '98 in the inshore area probably due to the industrial effluents discharged. However, in the open sea normal pH (8.3) was recorded.

BIODIVERSITY STUDIES (FEM/AR/1)

P.A. Thomas

As part of the investigations under the national project entitled 'Drugs from the Oceans', funded by DOD with CDRI and the nodal institute, the various Research Groups collected sponges and gorgonids from different parts of Indian coast and passed on to CMFRI for identification.

The Regional Research Laboratory, Bhubaneswar, made an extensive survey of marine organisms off Orissa coast at depths of 90-110 feet. About 55 species of sponges and 10 species of gorgonids were identified in these collections which is the first of its kind from greater depths off Orissa coast. This team made an extensive study on microbes/ fungi which grow in association with the identified species and identified areas where both drug industry/other industries could be benefitted. They include:

1. Discovery of many new microbes useful in production of maltose sugar.
2. Microbes useful in the digestion of cellulose.
3. New asperaginase used in the treatment of lymphatic leukaemia/tumor.
4. Enzyme to detect low level of environmental organophosphorus.
5. Enzyme useful for the removal of urithane from alcoholic beverages.
6. A new strain of bacteria useful in controlling pathogenic fungi in rice/other plant and
7. A new ecofriendly nontoxic antifouling compound.

SANITARY SIGNIFICANCE OF FAECAL COLIFORMS IN SELECTED COASTAL ENVIRONMENTS GROWING MARINE SHELLFISHES (FEM/MB/1)

V. Chandrika

Investigations were carried out on TPC and Coliforms from Dalavapuram, Cherai and Chettuva using water and sediment samples to find out whether any correlation exists between contaminants (*E.coli* and TPC) and pathogenic organisms eg. (*Salmonella*).

Of the 28 samples analysed, 25 were positive for coliforms and 3 negative. The *E.coli* count of the waters ranged from 0.5 x 10^3 per 100 ml to 9.6 x 10^5 per 100 ml.

The distribution of *E.coli* and *Streptococcus faecalis* in the three shellfish-growing areas showed that even though coliform intensity in these areas was the same, total plate count showed less variety of microbes in Dalavapuram samples. Diversity of microbes was less due to anthropogenic influences for shellfish farming when compared to other two areas like Chetuva and Narakkal.

MARICULTURE OF LIVE FEED ORGANISMS (FEM/LF/1)

K.G.Girijavallabhan, C.P. Gopinathan,P.Kaladharan, T.S. Naomi, Rani Mari George, S. Jasmine, Molly, Varghese, Reeta Jayasankar, M.Rajagopalan, P.T.Sarada, K. Vijayakumaran, D. Sivalingam and D. Kandaswamy

Eight species of microalgae were maintained at the Algology laboratory as stock culture. Utilising the inoculam of this stock culture, mass culture of required species

was carried out for providing as livefeed for zooplankters (Rotifer, cladoceran) and rearing the larvae of molluscs, crustaceans and fishes.

At the FHL, the procedures were standardized for the estimation of available chlorine from bleaching powder, sodium hypochlorite solution as well as culture water and this method would be very useful for the culture of livefeed organisms under laboratory conditions. The experiments were carried out to study the effect of farm chemicals (Ammonium sulphate, urea and super phosphate) in rotifer culture system.

Vizhinjam: Mass culture of *Chlorella* and *Tetraselmis* was carried out in perspex tanks under laboratory conditions. Making use of inoculam of these microalgae including *Isochrysis*, the stock culture of rotifers was maintained under laboratory conditions.

Mandapam : The mass culture of zooplankton viz. Rotifer (*Brachionus plicatilis*), *Moina* and *Artemia* were maintained to feed the different stages of crustaceans and finfish larvae. The high saline (60-70%) *Chlorella* culture was also maintained to feed *Artemia salina*.

Visakhapatnam: Stock culture of four species of microalgae was maintained and they are being used as live feed for larvae and brood stock of fishes, crustaceans and molluscs grown in hatcheries.

Minicoy: Mass cultures of *Chaetoceros* sp. *Tetraselmis* sp. *Isochrysis* sp. *Nannochloropsis* sp were undertaken using pottasium nitrate, sodium orthophosphate, EDTA and Sodium silicate. Both for marine and freshwater *Chlorella* culture, commercial fertilizers were used. Both marine and freshwater *Chlorella* had grown well.

Moina sp and Rotifer were cultured using Chlorella as food.

Cochin: Fine powder of the seaweeds *Gracilaria edulis* and *Ulva lactuca* was given as food for bivalves and the rate of feeding was monitored. *G.edulis* was incorporated as one of the ingredients and as a binder compounded feed was prepared for shrimps and fish.

CONSERVATION OF MARINE TURTLES (FEM/MT/1)

M. Rajagopalan, S. Krishna Pillai and K.M.S. Ameer Hamsa

The phenomenon of "arribada" or mass nesting of the olive ridley *Lepidochelys olivacea* along the Gahirmatha beach Bhitarkanika Wildlife Sanctuary, Orissa did not occur during the 1998 season. Though the exploitation of sea turtles has been drastically reduced, a major threat which still persists along the Gahirmatha beach is the incidental catch of adult turtles in fishing gears like gill net and trawl net. During the 1998 season, around 16,000 olive ridley carcasses were washed ashore along the Gahirmatha beach

which was due to entangling in fishing operations.

The ICAR *ad-hoc* research scheme 'Conservation of Green Turtle' *Chelonia mydas* was initiated in August 1998.

The Ministry of Agriculture, (Fisheries Division) approved the funded project entitled 'Study on distribution, incidental catch, mortality of sea turtles in Indian waters and efficacy of turtle excluder device at selected centres'; this project was initiated in November 1998.

BREEDING, SEED PRODUCTION AND SEARANCHING OF SEA CUCUMBER, *HOLOTHURIA SCABRA*(FEM/HOL/1)

D.B. James and P.S. Asha

During the year 1998, the seed of *Holothuria scabra* produced during earlier years was grown in concrete rings for the first time in a prawn farm. The average weight increased from 22 g to 120 g in 10 months.

The bottom of the concrete ring was covered by a velon screen to prevent the juveniles from burrowing and escaping. The top of the concrete ring was also covered by velon screen to prevent the entry of other organisms into the ring. The concrete ring was set on an even ground at the corner of a pond in a prawn farm. The concrete ring was filled with surrounding mud from the prawn farm which is organically rich. The organic carbon of the soil was estimated at the time of stocking. Every month the juveniles were examined to find out the mortality and also the increase in average weight.

Juveniles of average weight 67 g were stocked in a prawn farm in June, 1998 and this average weight increased to 284 g in six months giving an increase of 36 g per month.

It is seen that if the brood stock material is maintained for more than one year in the laboratory, they become shrunken. In order to bring them to mature condition next season some broodstock material of average weight 168 g was stocked in a separate concrete ring in October, 1998; the average weight increased to 260 g in two months time. The average weight increase per month was 46 g. The average weight of brood stock material in the control tank was 174 g and the average weight of the brood stock material subjected to light and dark method was 223 g. The brood stock material grown in the prawn farm reached maximum average weight of 260 g. It is expected that they would reach the full size by March, '99.

ULTRASTRUCTURAL STUDIES OF MARINE ORGANISMS (CMFRI/IDP/EM/1)

K. Rengarajan, K.C.George, P.C.Thomas, N.Sridhar, N.K. Sanil and K.S. Shobana

The EM facility was extended to the Senior Research Fellows of the Institute and to outside institutions such as School of Environmental Studies, CUSAT, Cochin, Centre for Materials for Electronics Technology, Dept. of Electronics, Govt. of India, Trichur, for sample processing and block making for TEM and SEM.

PREPARATION OF A GUIDE FOR EGGS AND LARVAE OF INDIAN MARINE FINFISHES (CMFRI/IDP/EL/2)

K.J. Mathew, P. Bensam, N.G. Menon, P.N.R. Nair, Grace Mathew and T.S. Naomi

The list of 515 species on which details of eggs and larvae were collected was further screened for making a final list of those species occurring in the Indian EEZ by refering to authentic works such as Weber and DeBeaufort, Munro, Day, Bal and Rao, Jones and Kumaran, Talwar and Jhingaran etc. As a result of this, 163 species were to be deleted and consolidation of information on the shortlisted species was started. The writeups passed on by the project associates were carefully scrutinised and final account was prepared for 31 species.

VII . PHYSIOLOGY, NUTRITION AND PATHOLOGY DIVISION

DEVELOPMENT OF FEEDS AND OPTIMIZATION OF FEEDING REGIMES FOR CULTURABLE CRUSTACEANS, MARINE FINFISHES AND PEARL OYSTERS (PNP/35)

R. Paul Raj, M. Vijayakumaran, D. Kandasami, Preetha Panicker, D.C.V. Easterson, Manpal Sridhar and P. Vijayagopal

Development of feed

At Madras, work was continued in developing feeds and feed management for spiny lobsters, mudcrab and grouper. A maturation diet supplement rich in essential fatty acids, phospholipids, vitamin E, C and other vitamins and minerals was prepared and provided to feed the grouper broodstock at FHL, Cochin.

At Cochin, optimum protein : lipid ratios required in the diets of *Penaeus indicus* (1g initial wt.) were studied using semipurified diets. The ingredients used to formulate the test diets were albumin, clammeal, fishmeal, shrimpmeal, groundnut oil cake, tapioca flour, oil, vitamin and mineral mixes, lecithin and cholesterol. The protein levels were 35, 40 and 45 and lipid levels were 6,9 and 12 at each protein level. In a 28 day feeding trial, the best response in terms of growth, relative growth rate, protein efficiency ratio, food conversion ratio and productive lipid value was found to be at 45% protein and 12% lipids without any indication of an optimum level. Two way interaction between protein and lipid levels were not significant in any of the parameters tested. However, the effect of protein and the effect of lipids tested individually showed significant variations.

At Mandapam, *Epinephelus tauvina* (75 nos.) of mean weights 742g, 1515g and 2600g were stocked in 100 ton cement tanks. They were fed with fresh sardines on alternate days and the resultant growth rate was 147g per month with a feed conversion ratio of 5.7:1. A total of 140 groupers, segregated 3 weight groups (0.5, 0.5-1.0 and 1.0kg) were also stocked in 100 ton cement tanks. The fishes of 0.5kg group showed a monthly weight gain of 128g with an FCR of 3.9:1. The fishes of the size range 0.5-1.0kg showed a monthly growth rate of 137g with an FCR of 4.5:1 whereas monthly growth rate of the fishes of 1.0kg and above group was 170g with an FCR of 4.7:1. These were also fed with fresh sardines on alternate days. Grouper seeds of 4.5 g body weight and within the size range of 47-87mm were found to grow at the rate of 1.26g/day.

Livefeed culture

Ingestion rates of *Chaetoceros* spp. by pearl oyster spat were found to be 34.98+10.6 cells/hour/spat in 5-10mm size, 51.47+10.6 cells/hour/spat in 10-15mm size and 76.37+18.03 cells/hour/spat in 15-20mm size. Clown fish larvae could be reared successfully by feeding *Brachionus rotundiformis* (SS) supplied @ 1000 rotifers per larva per day.

Probiotics in shrimpfeeds

Attempts were made to enumerate bacterial numbers of *Penaeus indicus* in the gut as well as in some livefeeds and artificial feeds on ZoBells 2216 agar. Some of bacteria isolated from the gut shall be used as probiotics after carrying out antagonism and safety studies.

EFFECT OF ENVIRONMENTAL STRESSORS ON THE PHYSIOLOGICAL BEHAVIOUR OF CULTIVABLE MARINE BIVALVES (PNP/44)

M. Peer Mohamed, D. Noble and S.R. Krupesha Sharma

Crassostrea madrasensis was exposed to 20ppt, 30ppt and 40ppt salinities and survival rate studied for 60 days under room temperature. All remained alive for the first 30 days. The mortality was 40% in high salinity (40ppt) 20% at low salinity (20ppt). It appears that higher salinity is more detrimental and 30ppt is optimal for survival and, that edible oyster can accommodate a wide range of salinity conditions (20 ppt to 40 ppt) for about a month.

DISEASE INVESTIGATIONS IN MARINE FINFISH AND SHELLFISH (PNP/46)

M. Vijayakumaran, R. Paulraj, A.P. Lipton, S.R. Krupesha Sharma, Gaurav Rathore and Preetha Panikkar.

Madras: Prevalence of whitespot disease in commercial shrimp catches in Chennai fishing harbour was studied. Incidence ranged from 0-100% among various species. Mass mortality of early juveniles of *Penaeus monodon* in a superintensive culture farm was also investigated. The symptoms suggested bacterial or viral etiology. Studies were also conducted on spiny lobsters collected from holding centres with profuse mucus production and foul odour accompanied by spoilage of eggs at advance stage of development. 14 colonies of gram negative bacteria were isolated from water, eggs and tissue fluids. Another incidence of mass mortality was traced to sudden lowering of salinity from 30ppt to 9ppt.

Mortalities were reported during the first week of stocking in lobster juveniles of about 80g weight. No pathogenic *vibrio* were recorded in culture, probably due to severe stress due to catching, holding and transporting before being stocked for fattening.

Kakinada: Small and medium farmers did not have problem with whitespot disease. Blackgill disease was reported in *P. monodon* in a few farms. Bulging of gills and surfacing of prawns leading eventually to red disease and mortality, was also observed in a few farms after heavy rains.

Mandapam: Mass mortality of pearl oyster larvae was investigated. The rearing water contained 104 to 105 cfu/ml bacteria. High

bacterial load in rearing water is suspected to be one of the factors for mass mortality of pearl oyster larvae. Mortality of clown fish larvae is suspected to be due to deficiency of highly unsaturated fatty acids (HUFA). Bacterial involvement in mass mortality of grouper broodstock is being investigated.

FORMULATION OF NUTRITIONAL STRATEGIES FOR THE MANAGEMENT OF AQUACULTURE WASTES (NSMAW) THROUGH LOW POLLUTION DIETS FOR SHRIMP (PNP/47)

Manpal Sridhar, M. Peer Mohamed and P. Vijayagopal

Two, high-nutrient-dense experimental feeds (HND) were prepared using fishmeal, prawnmeal, squidmeal, groundnut oil cake, soyabeanmeal, tapioca flour, wheat flour, clam meat ,oil, cholesterol, vitamin mixture and mineral mixture incorporating chromic oxide at 0.5% level. The control feed had a crude protein content of 48.65% where as the HND feeds had a crude protein content of 52.41 and 54% respectively. HND feeds were prepared by incorporating squid meal instead of prawnmeal and the P/N ratios were found to be 0.63 and 0.65 for the HND diets. These feeds are being nutritionally evaluated.

DEVELOPMENT OF DNA FINGERPRINTS AND PROBES FOR DIAGNOSIS OF PATHOGENS OF FINFISH AND SHELLFISH (PNP/48)

P.C. Thomas and M.K. George.

The standard strains and field strains of bacterial pathogens isolated from the shrimp body as well as from aquaculture ponds were cultured in the laboratory. Genomic and plasmid DNA were isolated from them using alkaline lysis method , modified and standardized for the purpose. The protocol standardized for the plasmid isolation consists of the initial lysis of bacterial cell wall using lysozyme, followed by selective denaturation of nuclear DNA, and precipitation of covalently closed circular plasmid DNA was purified from proteins by neutral phenol extraction followed by precipitation with alcohol in the presence of salt. Spectrophotometrcial analysis of the DNA extracts were carried out followed by submarine electrophoresis and ethidium bromide staining of the electrophoretic gel to visualize the DNA.

The field strains revealed considerable variations in their plasmid profile and antibiotic resistance pattern. Differences were observed in the number of plasmids and molecular size of plasmid DNA. While the standard strain of *Vibrio parahaemolyticus* (Vp1)had only one plasmid of 19 kb, two of the field strains (Vp2 and Vp3) had multiple plasmids. Vp2 carried two plasmids of 3.5 kb

and 21 kb as against 5 plasmids of 3 kb, 5 kb, 5.5 kb, 23 kb and 35 kb in Vp3. Two other field strain Vp4 and Vp5 harboured only single plasmid.

The antibiotic resistance pattern of different strains was also investigated since antibiotic resistance is reported to be mediated by plasmid DNA. While the standard strain carrying single plasmid was resistant only to 7 antibiotics out of 20 tested, Vp2 and Vp3 were resistant to 11 and 12 antibiotics respectively.

Restriction trials were carried out by enzymatically cleaving the DNA. While the restriction digestion of genomic DNA was carried out with Hind III and Pst I, plasmid DNA was restricted with ECOR I and Pst I. Restriction of genomic DNA resulted in the generation of numerous fragments indicating the existence of too many recognition sites, because of which resolution of individual fragments under submarine electrophoresis became impracticable.

Restriction of the plasmid DNA of Vibrio with Pst I produced three fragments of 9.5, 6.0 and 4.5 kb sizes indicating the existence of three cleaving sites. However ECOR I had no sites.

Restriction analysis of the genomic DNA with rare cutting enzymes are envisaged to gene rate less numerous fragments which shall facilitate their better resolution on electrophoresis. Restriction analysis of the plasmid DNA using array of endonucleases has also been initiated.

POPULATION GENETIC STUDIES IN *RASTRELLIGER KANAGURTA, SARDINELLA LONGICEPS* AND *PENAEUS INDICUS* (PNP/49)

M.K. George, P.C. Thomas and P.Jayasanker

The study of the morphometric characteristics of mackerel was continued to evaluate the population genetic heterogeneity in the species .

The preliminary results of the principal component analysis of the 15 body dimensions taken from the mackerel samples from Ambalpuzha, Cochin and Chavakkad indicated that the variation in PC scores is significantly different between Ambalapuzha and Chavakkad.

INDUCED MATURATION OF GROUPERS (PNP/50)

M. Peer Mohamed, N. Sridhar, Manpal Sridhar and D. Noble

The procedure for incorporation of 17a-methyl testosterone in the form of pellets using cholesterol, gelatin and gum acacia powder was standardized. Specimens 2.9kg and 2.4kg were fed hormone incorporated pellets once in two days. The female

specimens yielded *oocytes* which were in size range of 320 to 350mm. Biopsy in males showed oocytes in degenerative state. Experiments are being planned to induce maturation through ovaprim as well as LHRHa. Inter conversion of females to males at harbour laboratory was successful.

IN VITRO EFFECT OF NEUROHORMONES ON OVARY DEVELOPMENT IN CRUSTACEANS (PNP/51)

N.Sridhar and M. Peer Mohamed

The procedure for assaying lipogenic enzymes in the ovary and hepatopancreas of *P.indicus* as indicators of the onset of maturation was standardized. Studies on the effect of certain steroids on the activities of lipogenic enzymes in the ovary and hepatopancreas were conducted. These experiments indicate the involvement of steroids on the onset of maturation in *P.indicus*.

Enzyme activity in the hepatopancreas of the female green mudcrab *Scylla tranquebarica* during different maturation stages was also studied. An experiment to determine the role of 5-hydroxytryptamine was successfully completed.

STUDIES ON THE EFFECT OF TOXINS, POLLUTANTS AND PROBIOTICS ON FISH HEALTH WITH SPECIAL REFERENCE TO IMMUNE SYSTEM (PNP/52)

K.C. George, N.K. Sanil and K.S. Sobhana

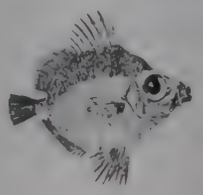
Histopathological studies of different organs of aflatoxin treated fishes were conducted . Damages to liver, spleen, kidney and lymphoid organs were recorded. Antibodies against fish serum proteins were raised in rabbits to develop methods for estimating fish immunoglobulins. Studies on the inflammatory reactions were done by injecting mineral oil into the tissues and assessing the responses histopathologically. Aflatoxin treated fishes showed poor leucocytic infiltration, indicating a reduced immune response.

EXTRACTION AND ISOLATION OF SUBSTANCES OF PHARMACOLOGICAL IMPORTANCE FROM MARINE ORGANISMS (PNP/53)

N.Sridhar, P. Kaladharan, P.A. Thomas, G.P. Kumaraswamy Achari, K.G. Girijavallabhan and A.P. Lipton.

Caulerpa racemosa collected from Rameswaram coast was tested for presence of cytokinin like substances (plant growth hormones). A procedure for preparation of

cytokinin group of substances was standardized and the prepared substance was assayed for cell elongation activity in comparison to commercially available kinetin . Seaweeds collected from Vizhinjam and Dalavapuram were extracted for gamma amino butyric acid (GABA) with chloroform and methanol mixture and the fine crystals obtained were preserved for further analysis. The procedure for determination of GABA from red seaweed was standardised using thin layer chromatography. The sponges collected from Rameswaram and ascidian from Vizhinjam were also processed for infrared spectral analysis for possible identification of bioactive components.



VIII. SOCIO-ECONOMIC EVALUATION AND TECHNOLOGY TRANSFER DIVISION

EMPOWERMENT OF COASTAL COMMUNITIES THROUGH FISHERIES EXTENSION (FE & E/31)

Sheela Immanuel and Jiju P. Alex

The programme of crab culture was extended through the *Kerala Pulayar Maha sabha* for 20 farmers through the SC/ST programme funded (Rs 2 lakhs) by the District Administration. Farmers having an area of 20 to 50 cents were selected. Each farmer was provided with 400 crabs, each weighing 100 to 150 g. Crab seeds purchased from a private entrepreneur was stocked during August in the respective fields. Trash fishes were given as feed. Regular monitoring of water parameters was done. Training was given to the farmers on pond preparation, stocking, feeding and other package of practices. A harvest festival was organised in this regard which was presided over by the District Collector. The farmers obtained an yield of 150 to 200 kg on harvesting in February.

A society was organised at Ottamassery, with the involvement of local people, to propagate the technology of mussel culture. This society serves as a link between the scientists and fishermen.

Ten farmers were identified as beneficiaries under the SC/ST programme to take up prawn culture; training was imparted to them and culture work was initiated. Farmers at Chellanam were encouraged to take up finfish culture, as the second phase of the integrated finfish culture project funded by the District Administration. In the culture of milkfish and mullet the farmers obtained very good harvests. Ornamental fish were provided to five farmers and the culture is in progress.

A project at a cost of Rs 8 lakh was sanctioned by the District administration to promote crab and finfish culture at Panampukad and Elamkunnapuzha and another project was sanctioned for an amount of Rs 2 lakh to implement group farming in prawn culture.

INTEGRATION OF SMALL SCALE MARICULTURE WITH SMALL SCALE FISHERIES ALONG THE PENINSULAR INDIA (FE & E/32)

M. Devaraj, A. Regunathan, N. Kaliaperumal, P. Jayasankar, A.C.C. Victor, D. Sivalingam, P.V. Srinivasan, M. Vijayakumaran, G. Syda Rao, G. Mohanraj, K. Vijayakumar, N. Ramakrishnan, Krishna Pillai, Sheela Immanuel, K.K. Appukuttan, P. Kaladharan, P.S. Kuriakose, C. Muthiah, Prathibha Rohit, Arpita Sharma, K.K.Philippose and I. Jagadish

Pulicat village (Tamil Nadu) was selected for transfer of technologies and a fishermen meet was organised.

The programme of mussel culture at

Manapad was abandoned for the current year due to damage caused to the raft off Kulasekharapattinam and nonavailability of seed. This programme is to be continued at Jeeva Nagar/Chungam during 1998-99 season under a part finance scheme between the C.M.F.R.I. and the fishermen group of Manapad.

Fisherwomen at Versova (Mumbai) showed readiness on packing and marketing of dried fish. The marketing of packed dry fishes is encouraged and slowly if this succeeds, a brand name by fisherwomen group and later a fisherwomen cooperative can come into picture.

Monthly meets were organised at the Headquarters, Regional and Research Centres regularly. The topics covered includes clam farming, fish culture, crab farming and prawn farming. The programmes organised in fishing villages have inspired the fishermen to take up the culture in their farms. High level participation from the fishermen community was observed, in all the programmes.

RESOURCE MANAGEMENT AND SOCIO-ECONOMIC SURVEY OF SMALLSCALE FISHERIES IN LAKSHADWEEP ISLAND AND KERALA (FE & E/33)

M. Sivadas and A.K.V. Nasser

Data on resource assessment and household details of selected villages at Lakshadweep and Kerala are being collected with the help of the interview schedule.

EVALUATION OF SOCIO-ECONOMIC CONDITIONS AND ERGONOMICAL PROBLEMS OF WOMEN ENGAGED IN PRAWN PEELING IN MUMBAI REGION (FE & E/35)

Arpita Sharma

Sixtynine women engaged in prawn peeling at New Ferry Wharf and Versova landing centres were interviewed. 57.97% followed Islamic religion and 42.03% followed Hinduism. Most of the women (82.61%) are married and have nuclear family (85.51%). The mean monthly income of women engaged in prawn peeling is Rs 813.04 and family income is Rs 2063.77. Number of earning members per family is 3. Reason for joining this job, as reported by them is economical. 82.61% of the women sampled migrated from other states mostly because of economic reasons. Only 15.94% are able to read and write. Most of the women stay in huts and some of them stay in chawls.

The landing centre is an open place and the working time depends on the catch.

Working throughout the week and more or less 7 hours per day existed here. They adopt continuous squatting posture for the whole work hours. The prawn peelers also report that because of pricking of rostrum of

prawns, in their palms they experience a lot of pain. All of them felt completely fatigued after the end of work and suffer high degree of body pain and musculo-skeletal pains specially in the lumbar region due to continuous forward bending during work hours.

In conclusion, the study revealed that the nutritional and socio-economic status of women engaged in prawn peeling is poor and they face occupational problems. The working conditions of these women also invites attention.

IX. SPONSORED PROJECTS

HATCHERY PRODUCTION OF CLAM (*MERETRIX* SP.) SEED (CMFRI/SPO/3)

P.V. Sreenivasan and D. Sivalingam

M. casta (150 numbers) of 28-51 mm length collected at Mandapam were transported and maintained as broodstock in the shellfish hatchery at Tuticorin. 5 spawnings of *M. casta* occurred, of which 2 were without stimulation and others by thermal inducement. However, larvae of all the 4 spawnings were attacked by ciliates. In the fifth spawning, 14.1 million larvae were reared and 2.3 million seed produced. Settlement occurred on the 7th day; settlement was 16.2%. The seeds after attaining 5-16.5 mm size were ranched in Punnakayal estuaries and creeks near Tuticorin.

HATCHERY PRODUCTION OF THE GREEN MUSSEL (*PERNA VIRIDIS*) SEED (CMFRI/SPO/4)

P.S. Kuriakose

During the period under report two successful spawning experiments were conducted in the hatchery. In the first spawning on 21.2.1998, 20 males and 24 females spawned. A total of 5.65 million larvae were reared up to 7th day. Spat settlement commenced on the 18th day and a total of 0.904 million spats settled in the rearing tanks. The spats were further reared upto the seed size and a total of 0.47 million seeds were produced in the hatchery. The hatchery produced seeds were kept in the Puthiappa fisheries harbour for further growth up to 30 mm size.

The second experiment was conducted on 12.3.98, in this experiment 9 males and 13 females spawned in the hatchery. A total of 1.8 million veliger larvae were reared upto 7 days. On the 30th day 0.504 million spats settled in the larval rearing tanks. The spats were further reared upto the seed size of 10-12 mm in the nursery rearing tanks. The seeds produced were sea-ranched.

Stock cultures of 5 species of micro-algae were well maintained in the temperature controlled room. Mass cultures of micro-algae and phytoplankton were developed in one tonne capacity FRP tanks for feeding the larvae and juveniles in the hatchery.

TISSUE CULTURE IN PEARL OYSTER (CMFRI/SPO/6)

S. Dharmaraj

Three explant cultures of pearloyster mantle were organised during the year. Mediums 199 and L-15 were used. Since foetal calf serum was not available,

whole-body extract was used as a substitute. A few cells were found to dissociate. Development of microbes was observed and control measures were taken.

COMMERCIAL PROPAGATION OF MARINE PEARL CULTURE TECHNOLOGY (CMFRI/SPO/7)

A.C.C. Victor, A. Chellam, D. Kandasamy and I. Jagadis

The infrastructure facilities at the Mandapam Regional Centre were developed with the assistance of Rs.25 lakhs from DOD under MRDF programme fund with the aim of commercialising the pearl culture technology for the benefit of farmers and entrepreneurs.

The seawater pumping and filtration system was strengthened by extending the intake point in the sea by 3 m, four pairs of 100 t RCC tanks were constructed for rearing of nucleated oysters and four air-blowers commissioned.

A hatchery of 2 million capacity was developed along with phytoplankton culture laboratory and mass culture facility. Open sea farm 'Racks' (1.44 sq.mt) and raft (of 3 x 3m) were established at the Gulf of Mannar.

Induced spawning of pearl oysters was carried out by temperature manipulation. Seven successful spawnings were achieved during June 1997 to August 1997 and 90 lakhs larvae were produced of which 7.2 lakh spat were raised and reared. The percentage of spat recovery ranged from 4.3 to 16.0%.

Rearing of oysters juvenile was carried out in both the Gulf of Mannar and the Palk Bay. In the Gulf of Mannar, juveniles were reared in box type cage suspended from 3x3 m rafts at a stocking density of 1500/cage. The spats were periodically thinned, at the end of six month culture period the spats from an average size of 7.2 mm had reached 44.9 mm showing a monthly growth of 6.3 mm. The survival was 50%. Spats of larger size (Av. 16.6 mm) stocked at 1500 nos/cage attained an average size of 24.9 mm within 1 1/2 months of culture, registering 5.5 mm/month. The survival was 80%.

Initial experiments conducted in the Gulf of Mannar yielded satisfactory result of pearl production. The quality of the pearls produced was high and comparable to that of Japanese pearls.

To develop the expert manpower in the nucleus implantation technique, a training programme was conducted for 15 women in all aspects of pearl culture.

APPLICATION OF REMOTE SENSING TECHNIQUE TO MARINE FISHERIES (CMFRI/SPO/11)

V.N. Pillai, C.P. Gopinathan, V.K. Pillai, M. Srinath, M. Ferozkhan, Rani Mary George and M. Sivadas

A joint collaborative research project viz. "Identification of PFZ in the Coastal Waters" was taken up with Space Application Centre, Ahmedabad and a workplan was finalised for the project "Ocean colour applications" after undertaking detailed discussions with the concerned scientists both at Ahmedabad and Cochin. A background paper based on historic data was prepared and discussed during the seminar held at Ahmedabad during February, 1999.

Multi season, concurrent chlorophyll and SST images would be generated from Sea WiFS/OCM and AVHRR data. Thermal and colour features would be compared to understand the aspects like what additional information is available from the colour gradient, whether the two parameters co exist and collected or not, period (season) of collocation, whether colour front is more persistent etc. Clustering technique based on image classification would also be attempted to understand relation between the two parameters. Based on the understanding gained through this study, an approach to generate the fishery forecasts using combined data set (SST and chlorophyll) would be developed.

TECHNOLOGY ASSESSED AND TRANSFERRED

Open sea mussel culture was initiated at Narakkal as a demonstration programme with the involvement of four fishermen. The fishermen were trained in fabrication of raft and mussel seeding. The bamboo raft of 25 sq m (5 x 5) was moored off Narakkal at a depth of 4 to 5 m with the help of the fishermen.

For mussel seeding also local women were given a training in October 1998 by KVK, Narakkal and after training, the women actively participated in mussel seeding. Mussel seed was collected from the intertidal zone of Narakkal beach. Mussel seed (average length 27.1 mm; breadth 15.6 mm; depth 9.65 mm, total weight 2.45 g; meat wt 0.6 g) were seeded at a density of 1.5 kg/m length of nylon rope. About 58 seeded mussel ropes of 12 mm diameter of length 3 m were seeded and suspended from the raft.

In November due to the twisting of anchor ropes on the seeded ropes due to rough sea condition, intense seed slipping was observed. Mussel seed was stocked in nylon bags to reduce labour and time. Initially nylon net tubes of length 1.5 to 2 m were made. In each tube, mussel seed collected from

Narakkal were stocked in 5 to 6 pouches separated by knots tied at equal intervals. The stocking density was 200 g/pouch. 28 net tubes (each with 5 to 6 pouches) were prepared using 33.2 kg of seed. These nylon bags were suspended from the raft in December 1998.

EDUCATION AND TRAINING

Postgraduate Programme in Mariculture

In the M.F.Sc. programme, 7 students of 1996-97 batch completed their course and passed the examination. Nine students of 1997-98 batch completed their third semester and moved to final semester. Ten students of 1998-2000 academic year, joined the programme in September, 1998 and completed the first semester. One student of this batch, discontinued the programme due to personal reasons.

In the Ph.D. Programme, all the 3 candidates of 12th batch (1994-97) submitted their theses. The viva-voce of two of them was also over and the results are awaited. Among the four students of the 13th batch (1995-98), one student has completed his work and the work of the remaining three was progressed well. The research work of 10 students of the 14th batch and 12 students of the 15th batch has also progressed well. The fresh batch of students (16th batch) admitted to the Ph.D. programme during the year under report has completed the first semester course work and commenced the second semester.

Krishi Vigyan Kendra

Frontline Demonstration

The feasibility of farming of mussels was demonstrated to the local fishermen, was by floating a raft in the sea near the KVK campus and tying about 20 seeded ropes to it. Periodical observations were made involving the same fishermen.

The Krishi Vigyan Kendra conducted thirtythree training programmes during 1998 and the details are given below:

KRISHI VIGYAN KENDRA

Training Programmes conducted during 1998

S.No.	Subject	Duration (days)	No. of courses conducted	Trainees		
				Male	Female	Total
A. FISHERIES						
1.	Prawn farming	5	4	10	63	73
2.	Prawn farming	1	1	30	35	65
3.	Fish farming	5	1	5	19	24
4.	Mussel farming	2	2	8	24	32
5.	Pearl oyster farming and pearl production	15	1	-	20	20
6.	Pearl oyster farming and pearl production	10	1	1	21	22
7.	Prospects of self employment in fisheries for rural youth	1	1	4	21	25
B. AGRICULTURE						
1.	Coconut cultivation	2	2	1	25	26
2.	Vegetable cultivation	2	1	-	20	20
3.	Vegetable cultivation	1	4	71	75	146
4.	Kitchen garden	1	3	18	40	58
5.	Pest control in vegetables	1	2	24	16	40
6.	Mushroom cultivation	2	3	4	46	50
C. HOME SCIENCE						
1.	Preparation of low cost Nutritional food	1	1	6	19	25
2.	Fruit processing	1	2	-	43	43
3.	Health and Hygiene	1	2	-	36	36
4.	Health and Nutrition	1	2	-	42	42
	TOTAL		**33**	**182**	**565**	**747**

Trainers' Training Centre

During the period under report, ten short-term training courses were organised availing the expertise at CMFRI, Kerala Agricultural University, CIBA, CIFT and the Integrated Fisheries Project. The courses were conducted at Cochin, Vizhinjam, Calicut, Mandapam and Tuticorin. Rs 92,000 was collected towards course fee during the year. The training programmes conducted are given below:

Particulars of Training Programmes conducted by the TTC

Sl. No.	Title of the course	Duration	No. of courses conducted	No. of participants
1.	Mud crab farming	19.1.98 to 24.1.98	1	14
2.	Ornamental fish culture	16.3.98 to 21.3.98 and 26.5.98 to 30.5.98	2	21 14
3.	Hatchery production of marine prawn seeds	16.3.98 to 28.3.98	1	3
4.	Marine pearl culture	16.3.98 to 4.4.98	1	3
5.	Integrated training course on Fisheries Education	16.4.98 to 6.5.98	1	9
6.	Culture, processing & marketing of edible oyster	16.9.98 to 25.9.98	1	10
7.	Seaweed culture and utilisation	21.9.98 to 30.9.98	1	10
8.	Live feed culture	24.11.98 to 28.11.98	1	12
9.	Finfish Mariculture	1.12.98 to 11.12.98	1	7
	TOTAL		**10**	**103**

Other Training Programmes

Mr. T.A.Rajpakse, Research Assistant, National Aquatic Resources Research and Development Agency, Sri Lanka underwent Short-term Training Programme from 5.5.1998 to 30.5.1998 at CMFRI, Cochin, in the areas of Fish Taxonomy and Fish Preservation Techniques, under Dr. V. Sriramachandra Murty, Head, Demersal Fisheries Division.

AWARDS AND RECOGNITIONS

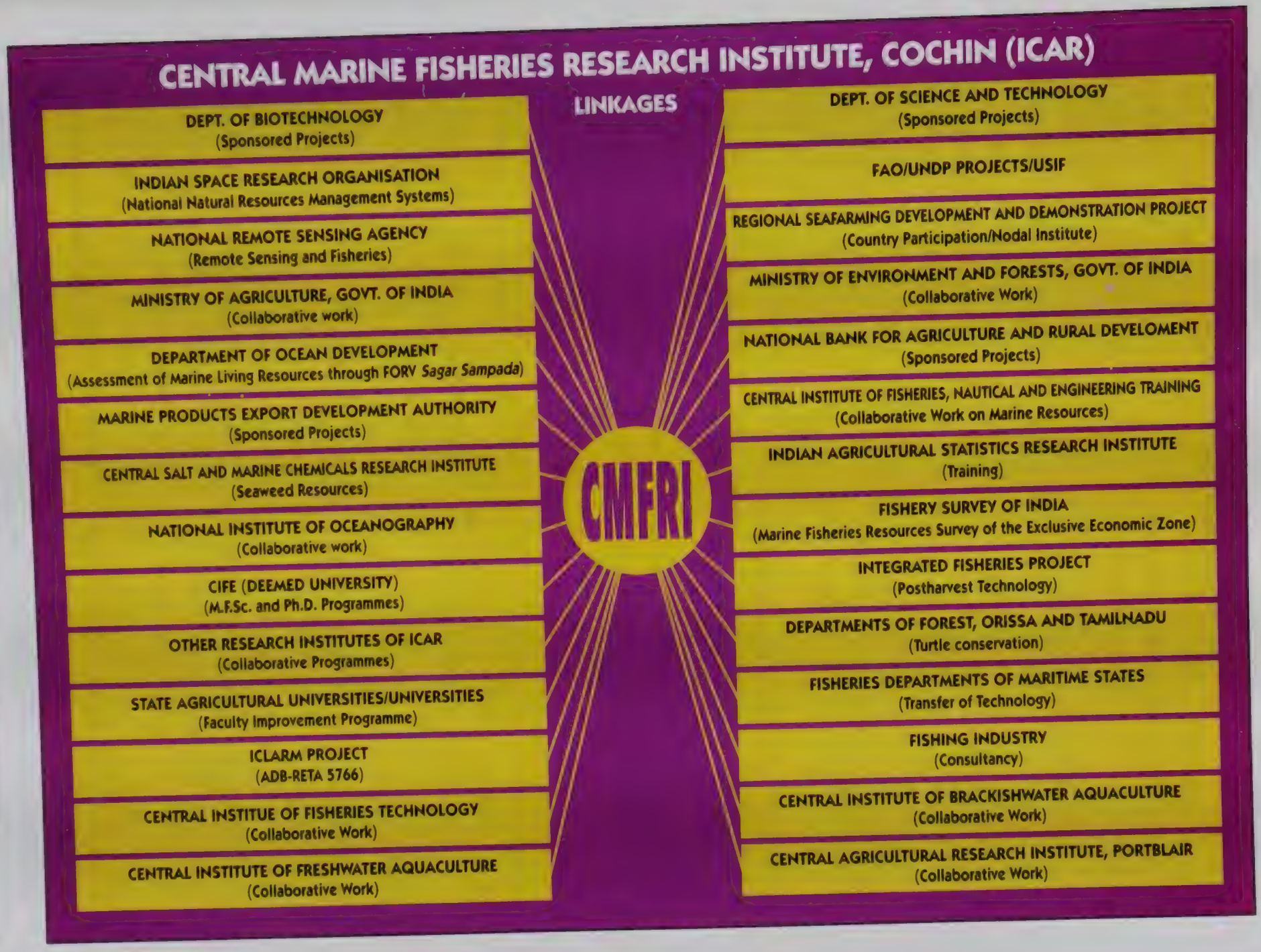
Shri G.S.D. Selvaraj, Senior Scientist, received the Best Research Paper Award for his paper "An Approach to Differentiate net Photosynthetic and other Biochemical Production and Consumption of Oxygen in Estuarine Waterbodies and Aquaculture Systems" during the National Seminar on Development and Transfer of Fisheries Technology, in February 1999, by the Fisheries College and Research Institute, Tuticorin (TANVASU).

The Institute received the *Rajbhasha* Rolling Trophy from Cochin TOLIC for the best Hindi Implementation Programme for the year 1998.

Shri G. S. Daniel Selvaraj, Sr. Scientist receiving the award for Best Research Paper

In the CMFRI- sponsored *Rajbhasha* Poster Contest - Dr. A. A. Jayaprakash, Sr. Scientist, CMFRI receiving the cash award

Shri P. Bapaiah, Senior Administrative Officer receiving the *Rajabhasha* Trophy from the Chairman, Cochin TOLIC for the best Hindi implementation programme for the year 1998


CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN (ICAR)
LINKAGES
CMFRI
DEPT. OF BIOTECHNOLOGY
(Sponsored Projects)
INDIAN SPACE RESEARCH ORGANISATION
(National Natural Resources Management Systems)
NATIONAL REMOTE SENSING AGENCY
(Remote Sensing and Fisheries)
MINISTRY OF AGRICULTURE, GOVT. OF INDIA
(Collaborative work)
DEPARTMENT OF OCEAN DEVELOPMENT
(Assessment of Marine Living Resources through FORV Sagar Sampada)
MARINE PRODUCTS EXPORT DEVELOPMENT AUTHORITY
(Sponsored Projects)
CENTRAL SALT AND MARINE CHEMICALS RESEARCH INSTITUTE
(Seaweed Resources)
NATIONAL INSTITUTE OF OCEANOGRAPHY
(Collaborative work)
CIFE (DEEMED UNIVERSITY)
(M.F.Sc. and Ph.D. Programmes)
OTHER RESEARCH INSTITUTES OF ICAR
(Collaborative Programmes)
STATE AGRICULTURAL UNIVERSITIES/UNIVERSITIES
(Faculty Improvement Programme)
ICLARM PROJECT
(ADB-RETA 5766)
CENTRAL INSTITUE OF FISHERIES TECHNOLOGY
(Collaborative Work)
CENTRAL INSTITUTE OF FRESHWATER AQUACULTURE
(Collaborative Work)
DEPT. OF SCIENCE AND TECHNOLOGY
(Sponsored Projects)
FAO/UNDP PROJECTS/USIF
REGIONAL SEAFARMING DEVELOPMENT AND DEMONSTRATION PROJECT
(Country Participation/Nodal Institute)
MINISTRY OF ENVIRONMENT AND FORESTS, GOVT. OF INDIA
(Collaborative Work)
NATIONAL BANK FOR AGRICULTURE AND RURAL DEVELOMENT
(Sponsored Projects)
CENTRAL INSTITUTE OF FISHERIES, NAUTICAL AND ENGINEERING TRAINING
(Collaborative Work on Marine Resources)
INDIAN AGRICULTURAL STATISTICS RESEARCH INSTITUTE
(Training)
FISHERY SURVEY OF INDIA
(Marine Fisheries Resources Survey of the Exclusive Economic Zone)
INTEGRATED FISHERIES PROJECT
(Postharvest Technology)
DEPARTMENTS OF FOREST, ORISSA AND TAMILNADU
(Turtle conservation)
FISHERIES DEPARTMENTS OF MARITIME STATES
(Transfer of Technology)
FISHING INDUSTRY
(Consultancy)
CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE
(Collaborative Work)
CENTRAL AGRICULTURAL RESEARCH INSTITUTE, PORTBLAIR
(Collaborative Work)

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CONSULTANCY, PATENTS, COMMERCIALISATION OF TECHNOLOGY

Sl. No.	Client	Amount In Rs.	Type of projects
	Projects completed during 1998-99		
1.	Mangalore Refinery & Petrochemicals Ltd., Mangalore	3,60,000	Consultancy
2.	Indian Tropical Agro Products (P) Ltd., Tuticorin	1,50,000	Consultancy
3.	Kudremukh Iron Ore Co. Ltd., Mangalore	3,80,000	Consultancy
4.	Care India, Mumbai	3,30,000	Consultacy
5.	Hardy Exploration & Production India (Inc), Chennai	9,60,000	Consultacy
6.	National Environmental Engineering Research Institute, Nagpur	4,59.000	Contract service
7.	Bharat Heavy electricals Ltd., Tiruchirappally	1,00,000	Contract service
8.	Hoava Foods Pvt. Ltd, Ezhupunna	2,000	Consultancy
9.	Tharakan Foods Private Ltd., Ezhupunna	10,000	Consultancy
	Ongoing Projects - 1998-99		
1.	Mangalore Refinery & Petrochemicals Ltd., Mangalore	4,00,000	Consultancy
2.	Cochin Port Trust, Cochin	4,01,370	Consultancy
3.	Indian Tropical Agro Products (P) Ltd., Tuticorin	1,50,000	Consultancy
4.	Rajiv Gandhi Centre of Aquaculture, Myladuthuria	5,88,280	Consultancy
5.	Kudremukh Iron Ore Co. Ltd., Mangalore	3,80,000	Consultancy
	Approved Projects		
1.	Lakshadweep Shilpi Aquaculture Ltd., Cochin	2,56,000	Consultancy
2.	Suganthi Devadasan Marine Research Institute (SDMRI), Tuticorin	15,000	Contract Service
3.	Master Pearl Ltd., Hyderabad	2,77,250	Consultancy
4.	Dept. Of Fisheries, A&N Administration, Port Blair	1,26,230	Consultancy

RESEARCH ADVISORY COMMITTEE, MANAGEMENT COMMITTEE AND STAFF RESEARCH COUNCIL MEETINGS

The **RAC meeting** was held on 21.1.1999 at the Calicut Research Centre. The RAC expressed satisfaction on the achievements of the Institute in the different programmes. The following recommendations were made.

- Action should be taken to patent the new technologies developed by CMFRI
- The hatchery of the Calicut Research Centre needs to be equipped for improving the training facilities at international level.
- Consultancy literature should be made available in regional languages

The **Management Committee Meetings** were held on 10-7-98 and 12.10.98 and the following decisions were taken.

- A proposal for construction of Hatchery-cum-Laboratory, Aquarium, retaining wall, development of site etc. for the Vizhinjam Research Centre of CMFRI, Vizhinjam at an estimated cost of Rs 39,63,460 was placed before the Management Committee in its meeting held on 10.7.1998. After going through all the relevant records, the Management Committee approved the construction of hatchery-cum-laboratory, Aquarium retaining wall and development of site etc. for the Vizhinjam Research Centre.
- Another proposal for collection of statistical data from Andaman & Nicobar Islands, Laccadives and Gulf of Kutch areas by posting officials or by opening new Centres , was placed before the Management Committee in its 50th meeting held on 10-7-1998. The Committee suggested that the CARI, Port Blair may be involved in obtaining the required data in respect of Andaman & Nicobar Islands. For Laccadives, the data may be collected by the Minicoy Research Centre of CMFRI by deploying additional hands. In regard to Gulf of Kutch, the Veraval Research Centre of CMFRI may collect the data by taking a room on rent at Rann of Kutch and by posting a person there. The Committee suggested to reopen the Field Centre at Kandla and also to open a new Field Centre in Gujarat.

The **SRC meeting** of the Institute was held on 4th & 5th June 1998 and the progress of the ongoing projects was discussed.

PARTICIPATION OF SCIENTISTS IN CONFERENCES, MEETINGS, WORKSHOPS AND SYMPOSIA IN INDIA AND ABROAD AND IN FOREIGN TRAINING

Name & Designation	Particulars	Date/s
Dr. M.Devaraj Director	The 26th State Fisheries Research Council meeting under the Chairman ship of the Hon'ble Minister for Fisheries, Govt. of Tamil Nadu at Chennai	June 23, 1998
	Management Committee of the Institute at Vizhinjam	July 10, 1998
	Syndicate and Establishment Committee meeting of the Manonmaniam Sundaranar University, Tirunelveli	July 11, 1998
	Meeting of the Environment Committee of Kerala Legislative Assembly, Legislative Complex, Trivandrum	July 14, 1998
	DPC Meeting of CIFE, Mumbai	July 20, 1998
	Meeting of the Committee of Expert Members convened by the Hon'ble Minister for Fisheries, Kerala at the Minister's chamber, Trivandrum	July 28, 1998
	Discussion with Fr. Tobias on pearl culture project at Arokyapuram	July 27, 1998
	Meeting with Hon'ble Minister for Fisheries, Govt. of Tamil Nadu	August 5 & 26, 1998
	Visited Iran as a member of the Indian team representing the Govt. of India to study the Marine Fisheries opportunities in Iran under bilateral cooperation	

Senate meeting of the Manonmaniam Sundarnar University, Thirunelveli	September 12, 1998
Second meeting of the Governing Body of the Fisheries Resource Management Society convened by the Hon'ble Minister for Fisheries, Govt. of Kerala at Government Guest House, Thycaud, Trivandrum	September 15, 1998
Workshop organised by the Department of Aquatic Biology and Fisheries, Kerala University in connection with the Golden Jubilee Celebrations of Indian Independence as well as the Diamond Jubilee of the Kerala University and delivered the keynote address on seafarming technologies for Kerala	September 23, 1998
Meeting of the Kerala Biodiversity Committee of Govt. Guest House, Thycaud, Trivandrum	September 24, 1998
Sitting of the Expert Committee on Marine Fisheries Resource Management in Kerala at CIFT Guest House, Ernakulam	September 19, 1998
Meeting for considering the requirements under catch-up grant convened by DDG (Education), ICAR, at CIFE, Mumbai	October 3, 1998
NATP launching ceremony at ICAR, New Delhi	October 6, 1998

ICAR Director's meeting at National Bureau of Plant Genetics Resources, Pusa, New Delhi	October 7-8 1998
Meeting of the Syndicate of Manonmaniam Sundaranar University at the University Building, Tirunelveli	October 10, 1998
Institute's Management Committee meeting at Mandapam Camp	October 12, 1998
DPC meeting of ISRO as an External Expert Member, at ISRO Satellite Centre, Bangalore	October 16, 1998
EFC discussions to finalise the IXth plan document pertaining to the four Research Institutes under the Chairmanship of Deputy Director General (Fy), at Krishi Bhavan, New Delhi	December 3, 1998
Inaugural function of Krishi Vigyan Kendra of Indian Institute of Spices Research at Peruvannamuzhi by Padmabhushan Dr. R.S. Paroda, DG, ICAR and Secretary to DARE, Govt. of India	December 7, 1998
Workshop on Sustainable Livelihoods and Environment Management in the Coastal Ecosystems organised by M.S. Swaminathan Research Foundation, Chennai and presented a paper	December 10, 1998
Inaugural function of the First National Seminar on Trends in Marine Biotechnology organised by Manonmaniam Sundaranar University,	December 14, 1998

Tirunelveli and delivered the inaugural address at the Bishop's House, Nagercoil	
XVII meeting of ICAR Regional Committee No. VIII at Indian Bank Management Academy for Growth & Excellence (IMAGE) Conference Hall, Rajah Annamalaipuram, Chennai	January 5-6, 1999
Syndicate Meeting of Manonmaniam Sundarnar University at Tamil Nadu State Council for Higher Education (TANSCHE), Kamarajar Salai, Chennai	January 7, 1999
Inaugural function of the National Seminar on Development and Transfer of Fisheries Technologies and gave inaugural address at Fisheries College & Research Institute, Tuticorin	February 3, 1999
Centre for Development & Transfer of Mariculture Technologies (CDTMT) meeting at the Office of the Director of Fisheries, Trivandrum	February 8, 1999
Scientific Workers' Conference of the Tamil Nadu Veterinary and Animal Sciences University at Madras Veterinary College, Chennai	March 13, 1999
Workshop on "The Small Scale Fisheries of India "organised by the Centre for Development Studies, Trivandrum under the WHAT Commission and presented a paper at Hotel Aquaserene, South Paravoor, Quilon	March 28, 1999

Dr. V.S.R. Murty, Head, DFD	National level consultation on development of protocols for access to biodiversity and consequent benefit sharing, at the Indian Institute of Management, Ahmedabad	April 10-12, 1998
	Meeting of the subcommittee on animals of the Ministry of Environment and Forests, Government of India, on the Identification of Repositories for maintaining voucher specimens of biological material transferred from the country, at NBAGR, Karnal	May 7, 1998
	Workshop on "Wetland Policy for India" organised by the worldwide fund for Nature, at New Delhi	
	Meetings of the Taskforce of the and project sponsored by the DOD on Stock assessment etc. at FSI, Visakhapatnam	June 20, 1998 March 8, 1999
	Delivered lecture on Demersal Fisheries Resources and Marine Ornamental Fish Resources at the MPEDA, Cochin	October 8, 1998
	Workshop on Germplasm Inventory and Genebanking of freshwater fishes, organized by the NBFGR, Lucknow, at the CMFRI, Cochin headed the scientific group on biology	October 12-13, 1998
	First meeting of the Steering Committee of the UNDP/GEF/PDF B Project on Management of coral reef ecosystems of Andaman and Nicobar islands; Ministry of Environment and Forests, Govt. of India, New Delhi	October 26, 1998

	International Symposium on Large Marine Ecosystems: Exploration and Exploitation for Sustainable Development and Conservation of Fish Stocks; Fishery Survey of India, and presented a paper	November 25-27, 1998
Ms.Sheela Immanuel, Scientist	Workshop on Fisheries Socio-economics and Management organised by ICLARM under the project on "Sustainable Management of coastal fish stocks in Asia" at Thailand	November 24 to December 1, 1998
Shri Jiju P. Alex , Scientist	Seminar on 50 years of communication research organised by the National Council of Development Communication at IARI, New Delhi	August 4-7, 1998
Dr. V.K. Pillai Sr. Scientist	Hindi Scientific Seminar on 'Changing Scenario in Marine Fisheries Research and New Dimensions' at CMFRI, Cochin presented a paper in Hindi on Training facilities in mariculture	March 3, 1998
Dr. P. Kaladharan, Scientist	on "Advances and priorities in Fisheries Technology" organised by SOFT and CIFT at Cochin and presented a paper	February 11-13, 1998
	The First National Seminar on "Trends in Marine Biotechnology" organised by the Institute for coastal area studies, Manonmanium Sundaranar University at Nagercoil and presented a paper	December 14-15, 1998
Shri G.S. Daniel Selvaraj, Sr. Scientist	National Seminar on 'Development and Transfer of Fisheries Technology at Fisheries College, Tuticorin	February 3-5, 1999

Dr. A.K. Unnithan Technical Officer	Intensive *Pokkali* (a variety of paddy) cultivation development programme and Farmers' Seminar organised jointly by Ezhikkara Grama Panchayat (Ernakulam District) and Krishi Bhavan of Dept. of Agriculture, Govt. of Kerala and delivered lecture on shrimp farming	May 21, 1998
	Farmers' Seminar organised by Dept. of Fisheries Govt. of Kerala in Kottuvally Panchayat (Ernakulam District) and delivered talk on 'Integrated farming in brackishwater areas'	July 4, 1998
	Delivered a talk over the Trichur Station of All India Radio on 'Crab farming'	September 9, 1998
Ms. K.S. Sobhana Scientist	Training Course on 'Hybridoma Technology for Aquaculture health management' at College of Fisheries, Mangalore	May 2-22, 1998
Dr.K.K. Appukuttan Head, MFD	Special invitation for lecture on Mariculture in India - on the occasion of 60th Anniversary of University of Kerala at All Saints College, Trivandrum under Talks on popular scientific topics.	August, 1998.
	Attended M.G. University M.Sc. (Fisheries) pre-valuation Board Meeting at Kottayam.	October 8, 1998

Participated in the syposium on "Advances and Priorities in Fisheries Technology" conducted by CIFT, Cochin	February 11-13, 1998
Attended meeting at Thriprayar, Trichur organised by AIR presented a paper on mussel farming Felicitation on behalf of the Director, CMFRI.	December 19, 1998
NATP attended meeting at Coimbatore and presented the details of the project on Bivalve seed production and farming.	December 21, 1998
Attended International Symposium on Large Marine Ecosystems: Exploration and Exploitation for sustainable Development and Conservation of fish stocks organised by Fishery survey of India at Cochin.	November 25-27, 1998
Attended Steering Committee meeting of Kollam Dist. Janakeeya Matsyakrishi at Kollam.	July 98
Attended National Seminar on Aquaculture in the Changing Environmental Perspectives organised by Dept. of Aquatic Biology & Fisheries, University of Kerala.	March 98
Attended 2 days Seminar on Pearl culture at Mandapam Camp organised by CMFRI	February 98

Shri T.S. Velayudhan, Senior Scientist	Participated in Workshop on Germplasm Inventory & Gene Banking, organised by NBFGR, Lucknow at CMFRI, Cochin.	October 12-13, 1998
Dr.P. Muthiah, Senior Scientist	Participated in seminar on Recent developments in Pearl culture, Grouper culture and crab farming at Mandapam Camp.	February 6-9, 1998
Dr.V. Kripa, Scientist (Sr.Scale)	Attended International Symposium on Large Marine Ecosystems: Exploration and Exploitation for sustainable Development and Conservation of fish stocks organised by Fishery survey of India at Cochin.	November 25-27, 1998
	Participated in the seminar on 'Sustainable Fishery resources management strategies for Kerala organised by Fisheries Resource Management Society, Kerala at Cochin.	August 8, 1998
Dr.P. Laxmilatha, Scientist	Participated in Workshop on Germplasm Inventory & Gene Banking, organised by NBFGR, Lucknow at CMFRI, Cochin.	October 12-13, 1998
Smt.Shoji Joseph, Scientist	Participated and presented a scientific paper in the National Seminar on trends in Marine Biotechnology at Nagercoil	December 14-15, 1998
Shri S.R. Krupesha Sharma, Scientist	Participated and presented a paper in the National Conference on Advances in Diagnostic Veterinary Pathology conducted by the Indian	November 9-11, 1998

	Association of Veterinary Pathologists at College of Veterinary & Animal Sciences, Kerala Agricultural University, Trichur.	
Dr. B. Manojkumar, Shri A.P. Dineshbabu, Scientists	Experience sharing workshop on "Fisheries sector development for the State of Gujarat" organised by the Commissionerate of Fisheries at IIM, Ahmedabad	September 22-23, 1998
Shri Joe K.Kizhakudan, Scientists	The Consultative Committee meeting of Fishery Survey of India, Porbander base at Gandhinagar	November 18, 1998
Shri K.Prabhakaran Nair, Sr. Scientist	31st meeting of TOLIC at Office of Chief Postmaster General, Thiruvananthapuram	April 24, 1998
	32nd meeting of TOLIC at Hindustan Latex Ltd., Peroorkada	August 28, 1998
	International Conference on Natural Resource Management and Conservation, Department of Environmental Science, University of Kerala, Thiruvananthapuram	November 19-20, 1998
	First National Seminar on Trends in Marine Biotechnology, Institute o Coastal Area Studies (ICAS), (M.S. University), Nagercoil	December 14, 1998
Shri G.P.K. Achary, Sr. Scientist	National Seminar on "Aquaculture in the Changing Environmental Perspectives" organised by Department of Aquatic Biology and Fisheries, Thiruvananthapuram	March 25-27, 1998
	Workshop on "Recent developments in cage culture and sea farming" at Mandapam Regional Centre of CMFRI, Mandapam Camp	June 26-27, 1998

	International Conference on "Natural Resource Management and Conservation", Department of Environmental Sciences, University of Kerala, Trivandrum	November 19-21, 1998
	Seminar on "Trends in Marine Biotechnology, ICAS, M.S. University Nagercoil	December 14-15, 1998
Shri G.P.K. Achary, Sr. Scientist Smt. S. Jasmine, Scientist	Joint Hindi Workshop at Sree Chitra Tirunal Institute of Medical Sciences and Technology, Thiruvananthapuram	November 13, 1998
Dr. Rani Mary George, Sr. Scientist	Seminar on Fisherwomen Welfare Co-operatives and Self Employment Schemes convened in connection with All India Aquarium Fare at Thiruvananthapuram	January 9, 1998
	National Seminar on "Aquaculture in the Changing Environmental Perspectives" organised by Department of Aquatic Biology and Fisheries, Thiruvananthapuram	March 25, 1998
	Workshop on "Remote Sensing Application for Kerala" at Thiruvananthapuram	March 27-28, 1998
Dr. A.P. Lipton Sr. Scientist	Seminar on "Recent Trends in Ultra-microtomy and Cryotechniques" at Trivandrum	April 9, 1998
	International workshop on the "Management and Culture of Marine Species used in Traditional Medicine" at Cebu, Philippines	July 5-9, 1998
	First National Seminar on "Trends in Marine Biotechnology" ICAS, M.S. University, Nagercoil	December 14-15, 1998

Shri D.C.V.Easterson, Sr. Scientist	Two day Workshop organised by M.S. Swaminathan Research Foundation on "Conservation of the Gulf of Mannar Marine Biosphere Reserve" and delivered a lecture on "Impact of Marine Pollution on the Ecological Resources of Gulf of Mannar"	
	National Seminar on "Coastal Zone Management" organised by Manonmaniam Sunderanar University, Tirunelveli and presented a paper on "Biodiversity, Coastal Zone and Management Strategies".	
	Tamil Nadu State Fisheries Advisory Board at Tuticorin	January 7, 1999
	Training course on Entrepreneurship Development Course at the Fisheries College and Research Institute, Tuticorin	November 9, 1998
	Committee meeting of CECRI, Tuticorin for selecting Research Associates	July 29, 1998
	Valedictory function of Training in chromosal Technology at Kamaraj College	October 26, 1998
Shri A. Chellam Sr. Scientist	First National Seminar on Trends in Marine Biotechnology at the Institute for Coastal Zone Management (MS University), Nagercoil and presented a paper "Biotechnological aspects in production of quality marine pearls	December 14-15, 1998.

	Delivered a lecture on Pearl culture' to the final year Degree students of Kamaraj College, Tuticorin	October 23, 1998
Dr. D.B. James Sr. Scientist	Seminar on Human Resources Development in Fisheries Sector in Tamil Nadu organised by Fisheries Technocrats Forum, Chennai	February 14, 1998
	Workshop on Coastal Biodiversity of Gulf of Mannar organised by M.S. Swaminathan Research Foundation at Chennai	February 10-11, 1998
Shri S. Dharmaraj, Senior Scientist	Participated and presented a scientific paper in the National Seminar on Trends in Marine Biotechnology at Nagercoil	December 14-15, 1998
Dr. N.G.K.Pillai Head, PFD Dr.P.P. Pillai Principal Scientist Shri M. Sivadas	Symposium on Advances and priorities in Fisheries Technology" SOFT/CIFT, Kochi	Februrary 11-13, 1998
Dr.N.G.K. Pillai Head, PFD	Sustainable fishery resource management strategies for Kerala organised by the Fisheries Resource Management Society, Kerala, Cochin	August 8, 1998
	Workshop on germ plasm inventory and genebanking of freshwater fishes Organised by National Bureau of Fish Genetic Resources,Lucknow at CMFRI, Cochin	October 12-13, 1998
	Colloquium on Marine Benthos organised by the Dept. Of Ocean Development, School of Marine Sciences, CUSAT, Cochin	March 6, 1999

	Task Force Meeting on "Harvest Technology and catch composition of deep sea fishery resources of Indian EEZ, organised by DOD/CIFT, Cochin	March 8, 1999
	International Symposium on Large Marine Ecosystems: Exploration and exploitation for Sustainable development and conservation of Fish stocks, FSI, cochin	November 25-27, 1998
Dr.C. Muthiah Senior Scientist	Meetings on "Brackishwater Fishfarmers Development Agency, Mangalore	September, 1998
	Meeting on Re-classification o mudflats under coastal zone management plan, Bangalore	September, 1998
	West coast zonal fisheries Meet, Mangalore	September, 1998
Dr. A.K. V. Nasser Scientist	Seminar on "Clean and healthy environment", Dept. of Science & Technology, Lakshadweep	June 1998
	Training Programme on "Live feed culture" TTC of CMFRI, Cochin	November, 1998
	Talk on "Protect our coral reefs and mangroves", AIR, Kavaratti	April, 1998
	"Marine Ecosystems and their conservation, Dept.Sci & Technol., Lakshadweep	December, 1998
Dr.A.A. Jayaprakash Senior Scientist	International Symposium on "Large Marine Ecosystem: Exploration and exploitation for sustainable development and conservation of fish stocks" FSI, Cochin	November 25-27, 1998

	UGC sponsored National Seminar On Ocean Fish and Fisheries, Iringalakuda	March 24-25, 1999
Mrs.Prathibha Rohit Scientist (Sr. Scale)	Talk in English on the Role of CMFRI in marine fisheries and mariculture at College of Fisheries, Mangalore, to Officers of the State Fisheries Depts. attending the Training Programme for officers of the State Fisheries Dept.	May 14-26, 1998
	Talk in Kannada on "Mussel and Clam Culture" at Nada Dhoni Meenugarara Sangha, Upunda to fisherwomen Participating in the Fisherwomen's Advanced training programme	September 22-26, 1998
	Meeting attended the Mangalore District level meeting convened by the District Collector held to discuss the causes of marine fish famine along Karnataka coast	October 24,1998
Dr.P.N.R. Nair Senior Scientist	"Sustainable fishery Resource Management Strategies for Kerala" organised by the Fisheries Resource Management Society, Kerala, Kochi	August 8, 1998
	International Symposium on Large Marine Ecosystem: Exploration and Exploitation for Sustainable Development and Conservation of Fish Stock by FSI, Cochin	November 25-27 1998
Shri K.P.Said Koya Scientist	Review meeting of KVKs/TTCs at Coimbatore	October 28-30, 1998
	Participated in the District level planning for implementation of Janakeeyasoothrana samithy at DD Fisheries, Ernakulam	May 4, 1998

	Panchayath level project formulation meeting at Nayarambalam	June 17, 1998
S/Shri K.P. Said Koya, P.P.Manojkumar, Dr.P.K. Martin Thompson, S/Shri A.N. Mohanan and P. Radhakrishnan	Organized and conducted the National Youth Week programmes in seven different places of Vypeen island for rural youth in association with field publicity office, Food and Nutrition board, Ernakulam and Tapovanam, an NGO at Puthuvype covering different subjects in Fisheries, Agriculture and Home Science	January 5-13, 1998
Shri P. Radhakrishnan Technical Officer	Workshop on water management organised by Kuzhupilly Panchayath at Ayyampilly	March 12, 1998
Dr.P.K.Martin Thompson, Shri A.N. Mohanan	Farmers' day programme at Chellanam organized by BFFDA, Ernakulam and and delivered lecture on "Prospects of prawn farming in Kerala and prawn farm management after stocking of prawn seed"	March 18, 1998 March 25, 1998
S/Shri A.N. Mohanan and B. Sureshkumar	Seminar and delivered a lecture on vegetable cultivation in three different Panchayath organised by and Dept. of Agriculture, at Alwaye	March 25, 1998, June 16, 1998 June 25, 1998
Dr. R. Paul Raj Sr. Scientist	Meeting of the Management Committee of CMFRI	March 23, 1998
	NATP Sensitization Workshop on Priority-setting, monitoring and evaluation in Agricultural Research organised by National Centre of Agriculture Policy, New Delhi	August 26-27, 1998

	ICAR Fisheries Institute Directors meeting at CMFRI and CIFT. Kochi	September 9-10, 1998
	Meeting of the Management Committee of CMFRI, Mandapam Camp	October 12, 1998
Dr. P. Nammalwar Sr. Scientist	National Review Committee Meeting on mangroves and coral reefs at Annamalai University, Tamilnadu, sponsored by Ministry of Environment and Forests, New Delhi	November 24-26, 1998
	Participated as resource person in the seminar/workshop on "Fisheries Management" at Quaid-E-Millath Govt. College for Women, Chennai	January 29-30, 1999
Dr. E. Vivekanandan Sr. Scientist	Presented the "Methodology on Fisheries Data Collection" in the GIS based Programme of DOD at Chennai	April 5-6, 1998
	Meeting on "Development of ornamental fish export" organised by the MPEDA at Chennai	August 27, 1998
	Ornamental fish breeders meet at Chennai	September 18, 1998
	Presented a series of lectures to the officials of Fisheries Department, Govt. of Tamil Nadu on Fish stock Assessment	September 15-19, 1998
	Presented a paper on "Experience sharing workshop on Gujarat Fisheries" in the Indian Institute of Management, Ahmedabad	September 21-22, 1998

	Regional Worshop on "Socio-economics and Management of coastal fisheries" conducted by the ICLARM at Hatyai (Thailand)	September 23 to December 1, 1998
Shri M. Sivadas Scientist (SS)	Symposium on "Large Marine Ecosystem: Exploration and Exploitation for Sustainable development and conservation of fish stocks organised by FSI at Cochin	November 25-27 1998
Shri Gulshad Mohamed Scientist	National Symposium on seaweeds and their utilization organised by Seaweed Research and Utilization Association and Department of Microbial Technology, Madurai Kamaraj University and presented two papers on seaweeds of Minicoy, Lakshadweep at Madurai	May 8-10, 1998
	International Conference on Natural Resource Management and Conservation (ICNRMC-'98) organised by Department of Environmental Sciences, University of Kerala at Thiruvananthapuram and presented a paper.	November 19-21, 1998
Dr. Kuber Vidyasagar, Shri M.Z. Khan, Dr. V.V. Singh and Ms. Arpita Sharma	National Seminar on 'Vision on Indian Fisheries of 21st Century' at C.I.F.E., Mumbai	February 7-8, 1998
Dr. Kuber Vidyasagar Sr. Scientist	29th Consultation Group meeting at FSI, Mumbai	April 2, 1998
	Colloquium on predictive Modeling for Marine Fisheries at CIFE, Mumbai	May 5-6, 1998
	A function arranged by the State Govt. of Maharashtra with open session of	

	officials and fisherfolk on the topic 'Fisheries status and future predictions of Konkan Area"	August 25-26, 1998
	A Fishery workshop organised by State Government	October 10, 1998
Dr. Kuber Vidyasagar, Dr. V.D. Deshmukh, Shri S.G. Raje, Dr. V.V. Singh and Ms. Arpita Sharma	A talk on 'Evolutions in Fisheries jurisdiction and management' by Mr. Satya Nandan, Secretary General of International Sea bed authority of United Nations at CIFE, Mumbai	November 11, 1998
Dr. Kuber Vidyasagar, Dr. V.D. Deshmukh and Dr. V.V.Singh	Workshop on 'Fishery Resources along Maharashtra Coast and scope for deep sea fishing' organised by FSI, Mumbai and Karanja Machhimar Vividh Karyakari Sahakari Society Ltd., Karanja at Karanja, Maharashtra	January 16, 1999
Dr. V.V. Singh Sr. Scientist	Tutorial cum Workshop on IRS-P3 MOS data handling and utilization, Space Application Centre (SAC)	February 11-13, 1998
	Delivered a specially invited guest lecture on "Coastal Zone Management and Aquaculture" to the trainees of the training programme on essentials of Environmental impact assessment EIA studies related to Aquaculture Project	June 2, 1998
	Delivered a special lecture to the officers and staff at Fishery Survey of India, Hqrs. Mumbai on the occasion	August 6, 1998

	of "The World Ocean's Day" and on the topic "ICZM with reference to the Environment and Oceans"	
	Delivered a lecture in the Fisherfolk Cooperative Meet on topic "Machli Ke Utpadan Me Vriddhi" in Hindi in a state level function of the Fisherfolk Community	August 16, 1998
	International Symposium on large marine ecosystem: Exploration and Exploitation for Sustainable Development and Conservation of Fish Stocks at Cochin	November 25-27, 1998
	Second meeting on 'Use of dry ice in fishing vessels' organised by the Commissioner of Fisheries, Maharashtra State at FSI, Mumbai	January 18, 1999
Ms. Arpita Sharma	Workshop on Methodologies in Ergonomics at Industrial Design Center, Indian Institute of Technology (IIT), Mumbai	May 18-22, 1998
Shri Sujit Sundaram	Training course entitled 'Essentials of Environmental Impact Assessment (EIA) studies related to agriculture project organized by CIFE, Mumbai	May 25, 1998 to June 4, 1998
Shri S.G. Raje and Ms. Arpita Sharma	Presentation on topic 'Fishery Co-operative Society at Versova' and 'Fishery Co-operatives' respectively to fisherfolk arranged by Cooperative assistance and Relief Everywhere an International Organization and *Sagar Putra Vidya Vikas Sanstha*, Dabhol, Maharashtra	August 27, 1998

Dr. V.D. Deshmukh, Dr. V.V. Singh	National Symposium on Eco Physiology and Conservation on Aquatic Resources at Institute of Science, Mumbai	January 8-11, 1999
Dr.V.S.K.Chennubhotla Principal Scientist	National Workshop on coastal marine culture systems organised by the Department of Ocean Development, Govt. of India at Andhra University, Visakhapatnam	February 16-17, 1998
	UGC sponsored National Seminar on "Conservation of lakes in urban environment" at Vivek Vardhini College, Hyderabad	June 12-14, 1998
	Meeting convened by President, Confederation of Seafood Exporters Association, in connection with the visit of His Excellency Al I Riaz Iravash, Counsellate-General Islamic Republic of Iran at Hotel Grand Bay, Visakhapatnam	September 17, 1998
Dr. G. Syda Rao Sr. Scientist	Served as member, Board of Post-graduate studies, Dept. of Zoology, Andhra University, Visakhapatnam	
	Served as member in the expert group on "Marine Living Resources in SAARC countries" Centre for SAARC studies, Andhra University, Visakhapatnam.	
Shri K. Vijayakumaran Scientist	National Seminar on Conservation of Eastern Ghats at Visakhapatnam and presented a paper on Propagation of two species of Palm as a part of integrated coastal zone management	March 24-26, 1998

	National Seminar on Aquaculture Economics at CIBA, Bhubaneswar and presented a paper .	October 6-8, 1998
	International Symposium on Large marine Ecosystem at Cochin and presented a Paper.	November 25-27, 1998
Dr. U. Rajkumar Scientist	National Workshop on Recent advances in hormonal physiology of fish and shellfish production at CIFA, Bhubaneswar .	April 16-18, 1998
	National Workshop on Development of Technical guidelines on Health certification and quarantine for the responsible movement of live aquatic animals at CIFA, Bhubaneswar	April 28-29, 1998
	The training programme on "Brackish-water finfish breeding" at CIBA, Chennai	November 16-30, 1998
	The training programme on application of statistical methods in Fisheries Research at CMFRI, Cochin	January 7-28, 1999
Dr. E. Dhanvanthari Scientist	National Workshop on Recent advances in hormonal physiology of fish and shell fish reproduction at CIFA, Bhubaneswar	April 16-18, 1998
	National Workshop on Development of Technical guidelines on Health certification and quarantine for the responsible movement of live aquatic animals at CIFA, Bhubaneswar	April 28-29, 1998
Shri P.U. Zachariah,	Meeting convened by the Deputy Commissioner, Dakshina Kannada	

	District to discuss about the fish famine along Karnataka coast during post monsoon months at Zila Parishad Hall, Mangalore	October 4, 1998
Smt. Rekha J. Nair Scientist	Symposium on "Advances & Priorities in Fisheries Technology" at CIFT, Cochin	February 11-13, 1998
Dr. S. Sivakami, Smt. Rekha J. Nair & Dr. K.K. Joshi,	International Symposium on Large Marine Ecosystems - Exploration and Exploitation for sustainable development and conservation of fish stocks organised by FSI, Cochin	November 25-27, 1998

WORKSHOP, SEMINARS, FARMERS' MEETS ORGANISED

1. Fishermen meet at Pulicat, Chennai on 6-8-1998 to extend the techniques of mussel, clam, edible oyster and pearl oyster. A total of 60 fishermen participated.

2. Training programme at Madras Research Centre for the officials of the Department of Fisheries, Govt. of Tamil Nadu on "Sampling methodology for collection of fishery statistics and fish stock assessment" from 15.9.98 to 24.9.98.

3. A Hindi Workshop at Minicoy Research Centre on 11th and 12th March 1999.

4. Seminar on "Recent Developments in Pearl culture, groupers and crab farming" was conducted at Mandapam Regional Centre of CMFRI, Mandapam Camp on 6th and 7th February 1998

5. Course Programme of Microbiology, Biochemistry genetics and Biotechnology for the post-graduate students of Professor Dhanapalan College for Women, Kalambakkam, Chennai from 19th to 21st February 1998.

6. Training course on "Finfish Mariculture" at Mandapam Regional Centre of CMFRI from 1st to 11th December 1998.

7. Training programme on "Hatchery management of penaeid shrimps" from 16-28 March 1998 at Mandapam Camp.

8. Training programme on "Seaweed culture and Utilization" from 21-30 September 1998 at Mandapam Camp.

9. Fisherfolk meet at the Mumbai Research Centre at Versova, Mumbai. Topic of the meet was 'Need of research and management in fisheries'.

10. Mumbai Research Centre organized a discussion with fisherfolk on 23.9.98 at Versova on topic 'Problems of Fisherfolk of Versova' in Hindi.

11. A 'Vyakhyan Mala' was organized at Mumbai Research Centre on 24.9.98.

DISTINGUISHED VISITORS

Cochin

Shri T.K. Ramakrishnan, Minister for Fisheries & Rural Development, Govt. Of Kerala

Dr. R.S. Paroda, Director General, ICAR, New Delhi

Tudor Amarasena Rajapakse, National Aquatic Resources Agency Colombo, Srilanka

Shri Ramsingh, IAS, Secretary, Department of Fisheries, Trivandrum

Gerbond Redoanz, Team Leader, Indo-German Reservoir Fisheries Development Project, Malampuzha

Shri Jyothilal, K.R., IAS, Director of Fisheries, Trivandrum

Dr. A. Alam, DDG (Engg.), ICAR, New Delhi

Dr. Martin Kumar, Sr. Scientist, SARDI, Australia

Dr. K. Gopakumar, DDG (Fy), ICAR, New Delhi

Veraval

Dr. A.V.R.L. Narasimhacharya, Reader, Department of Bio Sciences, Sardar Patel University, Vallabh Vidyanagar

Shri N.A. Vhora, Commissioner of Fisheries, Gujarat State and his team of Deputy Directors from Gujarat State Fisheries

Shri Dereck Johnson, IDRC Scholar, University of Gelph, Canada

Shri D. Biswas, Senior Engineer, CPWD, Rajkot

Dr. Gian Singh, Director and Dr. R.S. Vaghani, Senior Agronomist, VMA Oil Seed Research and Development Institute, New Delhi

Dr. S.L. Mehta, Deputy Director General (Education), ICAR, New Delhi

Dr. D.D. Malavia, Associate Dean (Agri.), Gujarat Agricultural University, Junagadh

Shri Madan Swaroop, Section Officer, ASRB, New Delhi

Mumbai

Shri Anil Kumar Joshi, Deputy Director (Hindi), ICAR, New Delhi

Shri Anil Kumar Dube, Director (Hindi), ICAR, New Delhi

Mangalore

Dr. P. Keshavanath, Professor & Head, Dept. of Aquaculture, College of Fisheries, Mangalore

Mr. Anupam Sharma, Senior Research Fellow, Dept. of Aquatic Biology, College of Fisheries,

Mangalore

Mr. Chandra Marakala, M.F.Sc. student, Dept. of Fishery Resources & Management, College of Fisheries, Mangalore

Dr. Ramachandra Bhat, Professor & Head, Dept. of Fisheries Economics, College of Fisheries, Mangalore

Shri B.K. Chauhan, IAS, Secretary, ICAR & Joint Secretary, DARE, Krishi Bhawan, New Delhi

Mr. Srikantha CNR, Project Fellow, DOD-ICMAM, Dept. of Marine Geology, Mangalagangothri.

Mr. V. Hariharan, Professor & Head, Department of Fishery Oceanography, College of Fisheries, Mangalore

Dr. M.N. Venugopal, Associate Professor, Dept. of Microbiology, College of Fisheries, Mangalore

Mr. P. Nagaraju, Chief Executive Officer, B.F.D.A., Brahmavar.

Vizhinjam

Dr. R.S. Paroda, Director General, ICAR, New Delhi

Shri K.R. Jyothilal, I.A.S., Director of Fisheries, Govt. of Kerala

Dr. E.G. Silas, Former Director of CMFRI and former Vice-Chancellor, Kerala Agricultural University

Dr. Martin S. Kumar, Senior Scientist, SARDI Aquatic Sciences, South Australia.

Shri T.A. Rajapakse, National Aquatic Resources Agency, Colombo, Sri Lanka

Shri A.K. Gupta, Director (Works), ICAR, New Delhi

Shri N. Vasudevan, Managing Director, Matsyafed, Thiruvananthapuram

Dr. Arun Varma, ADG ANP, Krishi Bhavan, New Delhi

Shri P.K. Chatterjee, I.A.S., Resident Commissioner of U.P., Government in Calcutta

Justice A.M. Mir, Jammu & Kashmir High Court

Shri V.S. Iyer, Atomic Energy Regulatory Board, Mumbai

Shri R.S. Bhandari, Principal Private Secretary to Director General, ICAR, New Delhi.

Dr. G.S. Dhaliwal, Professor, Horticulture, Punjab Agriculture University, Ludhiana, Punjab

Shri G.M. Srirangam, Head, Department of Industrial Fish & Fisheries, Andhra Loyola College, Vijayawada, Andhra Pradesh

Dr. K. Gopakumar, Deputy Director General (Fisheries), ICAR, New Delhi

Shri T.M. Jacob, MLA & Former Minister for Education, Govt. of Kerala
Members of Board of Management, A.N.G.R., Agriculture University, Hyderabad, Andhra Pradesh

Chairman & Members, RAC of CMFRI

Tuticorin

Mrs. Jenifer Chandran, Honourable Minister for Fisheries, Govt. of Tamil Nadu

Dr. Hansraj Verma, Director of Fisheries, Department of Fisheries, Tamil Nadu

Shri J.R. Nebhorio, Commissioner of Customs, Tiruchi

Shri T.K. Rajendran, I.P.S., DIG, Tirunelveli Range
Dr. M.N. Kutty, Retd. Professor, Puthur, Pallakkad

Dr. Usha Desai, Atomic Energy Regulatory Body, Mumbai

Dr. O.R. Reddy, Dy. Director (PP), Plant Quarentine Station, Ministry of Agriculture, Government of India, Chennai

Dr. G. Balasingam, FAO, Consultant, Lodi Estate, New Delhi

Shri K.P. Mishra, Commissioner of Customs, Patna

Shri S.X. Prince, Assistant Director (Aqua), MPEDA, Kochi

Mandapam Camp

Dr. (Mrs) Vasanthi Devi, Vice Chancellor, Manonmaniam Sundaranar University, Tirunelveli

Dr. M. Dorairaj, Assistant Conservator of Forests, Tirunelveli

Prof. K. Udayakumar, Director, College Development Council, University of Kerala, Trivandrum

Prof. R.V. Dhanapalan, Chairman, Prof. Dhanapalan College for Women, Kalambakkam, Chennai.

Dr. K. Muthunayagam, Secretary, Department of Ocean Development, New Delhi

Dr. S.P. Dasthakumar, Joint Secretary, UGC, New Delhi

Mr. R. Soundaraj, I.F.S., Chief Conservator of Forests, Madurai

Mr. Balendra Shukla, Minister of Science & Technology, Government of Madhya Pradesh

Mr. N. Govindarajulu, District Judge, Pudukottai

Tudor Amadarsana Rajapakse, National Aquatic Resources Agency, Colombo, Srilanka

S.R.C. Ajaykumar, Joint Secretary, CSIR, New Delhi

Prof. A.K. Kumaraguru, Madurai Kamaraj University, Madurai

Dr. R.S. Bhandari, Principal Private Secretary to Director General, ICAR, New Delhi

Director, CECRI, Karaikudi
Vice Admiral Vinod Pasricha, Indian Navy.

Kakinada

Dr. S. Rajagopal, Dept. Aquatic Ecology University of Nijmegen, 6525 ED NIJMEGEN, The Netherlands

Dr. D.E. Babu, Reader, Dept. of Zoology, Divn. of Physiol. and Aquaculture, Andhra University, Visakhapatnam

Dr. Max Troell, Ecologist, The Beijer Institute, The International Institute of Ecological Economics, The Royal Swedish Academy of Science, Stockholm, Sweden

Smt. J. Suguna, Lecturer, H.D. Degree College, AMG India International, Chilakalapudi, Guntur
Dr. P. Sardar, Scientist, CIFE Centre, Kakinada

Shri A.K. Yadav, Technical Officer and Shri S.K. Upadhayay, Trainees of Jammu & Kashmir from CIFE, Lucknow Centre

Shri R. Srinivasa Rao, Lecturer in Industrial Fish & Fisheries, Sri Subbaraya & Narayana College, Narasaraopet, Guntur.

Visakhapatnam

Dr. Ramamurty, Former Vice-Chancellor, Sri Venkateswara University, Tirupathi

Shri V. Luther Das, Dept. Zoology, Nagarjuna University, Nagarjuna Nagar alongwith his students

Professors and students of Scott Christian College, Calcutta

PERSONNEL (MANAGERIAL POSITION ONLY)

1.	**Director**	-	Dr. M. Devaraj
2.	**Heads of Divisions**		
	Fishery Resources Assessment Division	-	Shri K. Narayana Kurup Sr. Scientist
	Pelagic Fisheries Division	-	Dr. N.Gopalakrishna Pillai
	Demersal Fisheries Division	-	Dr.V. Sriramachandra Murty
	Crustacean Fisheries Division	-	Dr. G. Sudhakara Rao
	Molluscan Fisheries Division	-	Dr. K.K. Appukuttan
	Fishery Environment Management Division	-	Dr. V. Narayana Pillai
	Physiology, Nutrition and Pathology Division	-	Dr. M. Peer Mohamed Principal Scientist
	Socio-Economic Evaluation & Technology Transfer Division	-	Smt Sheela Immanuel Scientist
3.	**Sr. Administrative Officer**	-	Shri Nand Kishore
4.	**Sr. Finance & Accounts Officer**	-	Shri Radhey Sham
5.	**Administrative Officer**	-	Shri P.S. Sudersanan
6.	**Officers-in-Charge of Research Centres**		
	Mandapam Camp	-	Dr. A.C.C. Victor Sr. Scientist
	Chennai	-	Shri K. Dorairaj Principal Scientist
	Tuticorin	-	Shri D.C.V. Easterson Sr. Scientist
	Kakinada	-	Dr. H. Mohamed Kasim Sr. Scientist

Karwar	-	Dr. V.S. Kakati Sr. Scientist
Mangalore	-	Dr. C. Muthiah Sr. Scientist
Veraval	-	Dr. B. Manojkumar Scientist
Vizhinjam	-	Shri K. Prabhakaran Nair Sr. Scientist
Mumbai	-	Dr. Kuber Vidyasagar Sr. Scientist
Minicoy	-	Shri M. Sivadas Scientist (SS)
Visakhapatnam	-	Dr. V.S.K. Chennubhotla Principal Scientist
Calicut	-	Dr. P.S. Kuriakose Principal Scientist

SPECIAL INFRASTRUCTURAL DEVELOPMENT

Veraval

One generator and oil free compressor were purchased for the mariculture laboratory and the chemistry laboratory was fully equipped with chemicals and glassware to take up environment monitoring studies. Museum was further strengthened by procuring additional jars and adding up several biological specimens. New aquaria were constructed for the biological studies and display.

Calicut

A modern multipurpose hatchery complex was constructed by modifying of an existing building. The complex was inaugurated by Dr. R.S. Paroda, Director General, ICAR on 7-12-1998. The complex has facilities for conducting advanced research on breeding and hatchery production of seeds of fishes, crustaceans and molluscs. The main features are a 200-tonne capacity seawater storage sump, 6 numbers of 10-tonne capacity grow out tanks, 5 numbers of 5-tonne capacity larval rearing tanks, 6 nos of 10-tonne capacity nursery rearing tanks, 2 nos. Of 10-tonne capacity broodstock tanks, and area for mass culture of live feed organisms. The complex has air-conditioned laboratory for stock culture of microalgae, a modern biotechnology laboratory, conference hall, and a library.

Cochin

A Marine Hatchery Complex having an area of 7080 sq.ft. has been constructed at the Headquarters premises for TTC at a cost of Rs. 35 lakhs. The complex was inaugurated by Dr. R.S. Paroda, Director General, ICAR on 8.12.1998.

The residential complex at Cochin was inaugurated by Dr. R.S. Paroda, Director General, ICAR on 8-12-1998.

Madras

The renovation work of the existing mariculture experimental shed has been almost completed. A mini hatchery building for spiny lobster has also been completed. Work on the sedimentation tank, sand-filter, seawater sump and overhead tank has been completed. Work has been assigned to the CPWD to execute the seawater intake system, generator facility, street-lighting etc.

Mandapam

The construction of 100 ton RCC tanks with drainage system has been completed for the maintenance of live breeders of groupers. Erection of a small borewell in the intertidal area of Gulf of Mannar adjacent to CMFRI Jetty for drawing clean seawater for hatchery operations. Construction of a 2 cement platforms inside the pearl oyster hatchery to facilitate the gravitational flow of filtered seawater from the storage tank to the larval rearing tanks. Provision of asbestos sheet covering for the sumps and sedimentation tanks. Extension of the existing pearl oyster farm in the Gulf of Mannar sea to an area of about 0.075 ha capable of holding 1 million

Dr. R. S. Paroda, Director General, ICAR unveiling the plaque at the Calicut Marine Hatchery Complex on 7th December, 1998

Participants of the training course on livefeed culture held at Cochin

Multipurpose hatchery at Headquarters

Dr. R. S. Paroda, Director General, ICAR unveiling the plaque at the Residential Complex at Cochin on 8th December 1998

oysters of various sizes. An air-conditioned implantation room was set up at the southern part of the pearl oyster hatchery building for the nucleation of oysters under dust free environment.

The existing 8 small ponds were merged and convered into 3 grow-out ponds of 0.3 ha, 0.28 ha and 0.08 ha for shrimp culture experiments and the bunds have been elevated upto 0.3 m height at the fish farm. Drainout sump was constructed to provide alternate water exchange. Construction of sluice gates for 3 existing earthern ponds of 0.25 ha each for effective water exchange. Construction of water sump and erection of cement pipe lines to a distance of about 35 m from the shore to draw sea water through gravitational flow to the thereby feeding experimental culture ponds through pumping. Installation of 7 paddle-wheel aerators of 1 HP capacity each in the 5 experimental shrimp culture ponds for providing aeration. 3phase electrical supply was obtained from the EB to run the 12.5 HP motor for ensuring an interrupted supply of seawater to the ponds through the recently laid 6 dia PVC pipelines.

Visakhapatanam

Electrification of the new mariculture laboratory has been completed. Algal culture lab has been commissioned. FRP tanks were purchased for mariculture operations.

कार्यकारी सारांश

रिपोर्टाधीन वर्ष में सी एम एफ आर आइ ने अपनी चालू 67 परियोजनाओं को आगे बढाया। इसके अलावा भारत के ही अभिकरणों द्वारा प्रायोजित 12 परियोजनाओं जो कि 2 एस आइ डी ए और 1 आइ सी एल ए आर एम का है, का भी कार्यान्वयन किया।

विदोहित मात्स्यिकी संपदाओं का स्वरूप

वर्ष 1998 में देश में प्राप्त कुल समुद्री मछली उत्पादन 2.67 मिलियन टन था। यह पिछले वर्ष से 2% कम है। सब से अधिक पकड यंतीकृत यूनिट से मिली, यह 73% थी। बाकी के 19% मोटोरीकृत यूनिटों और 8% परंपरागत यूनिटों से प्राप्त हुए थे। देश में सब से अधिक मछली पकड गुजरात और महाराष्ट्र के उत्तर पश्चिम तटों से मिली थी। पकड का प्रतिशत 42 था। अन्य समुद्रवर्ती तटों का योगदान इस प्रकार है: दक्षिण पश्चिम क्षेत्र (केरल, कर्नाटक, गोवा) 28%, दक्षिण पूर्व क्षेत्र (आंध्राप्रदेश, तमिलनाडु व पोंडिच्चेरी) 24%, उत्तर पूर्व (पश्चिम बंगाल, उड़ीसा) 5%, लक्षद्वीप और आन्डमान 11%। पिछले वर्षों की तुलना में उत्तर पश्चिम तट के मछली अवतरण में 6,000 ट. की और दक्षिण पश्चिम तट में 71,000 ट. की घटती दिखयी पडी जबकि उत्तर पश्चिम तट में 60,000 ट. की बढती हुई थी। पिछले वर्षों की तुलना में पेनिआइड झींगों के उत्पादन में 3%, नॉन पेनिआइड में 13%, शिंगटी में 18%, थ्रेड फिन ब्रीम में 12% की बढती दिखाई पडी। वर्ष 1998 में पकडी गई मुख्य मछलियाँ और उनकी पकड डाटा इस प्रकार है: तारली (2.04 लाख ट.), अन्य तारली (1.00 लाख ट.) बाँगडा (1.77 लाख ट.), बम्बिल (1.23 लाख ट.)।

वेलापवर्ती, तलमज्जी पखमछली, क्रस्टेशिया व मलस्क मछली जातियों से सम्बन्धित डाटाओं का संग्रहण करके उसकी मात्स्यिकी और विदोहित संपदा अभिलक्षणों का विश्लेषण और अध्ययन किया गया।

तारली की पकड में पिछले वर्ष की तुलना में 8.5% घटती दिखाई पडी; मांगलूर में रिंग सीन के ज़रिए 50% मत्स्यन प्रयास बढाने पर पकड में 68% बढती हुई जबकि कोचीन में 0.9% मत्स्यन प्रयास बढाने पर पकड में 62% वृद्धि हुई थी।

एंचोवी मछली का अंडजनन अक्तूबर-मई के दौरान दिखाया पडा था।

वर्ष के दौरान सुरमइयों की पकड में वृद्धि दिखाई पडी (48,000 ट.)।

दक्षिण पश्चिम तट में प्राप्त बाँगडे मछली के आकार आयाम में कमी दिखाई पडी।

फीता मीनों में *ट्रिक्यूरस लेप्ट्यूरस* की जातियों की प्रमुखता थी, पकड में 90% इनकी जातियाँ थी और ये मुख्य रूप से ट्रॉल के ज़रिए पकडी गई थी।

अधिकतम करंजिड मछलियाँ ट्रॉल और पर्स सीन से पकडी गई थी।

देश में तलमज्जी पख मछलियों का कुल उत्पादन 0.7 मिलियन ट. था; इस में 68.1% ट्रॉल से, 13.2% अन्य यंत्रीकृत यूनिटों से, 10.2% मोटोरीकृत यूनिटों और बाकी 8.5% परंपरागत यूनिटों से प्राप्त हुए थे। तलमज्जी पख मछलियों की सब से अधिकतम पकड गुजरात से (38.7%) मिली थी। अन्य राज्यों का योगदान इस प्रकार है: तमिलनाडु 16.8%, केरल 13.9%, महाराष्ट्र 11.4%, कर्नाटक 6%, आंध्राप्रदेश 5.6%, पश्चिम बंगाल 3.3%, उड़ीसा 2.6%, गोवा 1.5% और पोन्डिच्चेरी 0.2%। तलमज्जी पखमछलियों की कुल पकड 8% बढती दिखाती है। इस बढती का कारण उत्तर पश्चिम तट में प्राप्त हुई वर्द्धित पकड है। मुम्बई की पकड में सुरा *स्कोलियोडॉन लाटिकाडस* प्रचुर मात्रा में उपलब्ध था। कोचीन में *कारकारिस मेलानोप्टीरस* और टूटिकोरिन में *सी. ब्लीकेरी* अधिक मात्रा में मिले थे। *एपिनेफेलस डयाकान्थस* मुम्बई में प्रचुर था।

थ्रेडफिन ब्रीमों में *नेमिप्टेरस जापोनिकस* और *एन. मिसोप्रिओन* की प्रचुरता थी। सितंबर-नवंबर की अवधि में कर्नाटक से *एन.मिसोप्रिओन* बहुमात्रा में प्राप्त हुए थे। भारत के दक्षिण पश्चिम तट से सिलवर बेल्लियों की अधिकतम पकड मिली थी; पश्चिम तटों में *एल. बिन्डस, एल. स्प्लेन्डन्स* और *एस. इन्सिडाटर* प्रचुर थे जबकि दक्षिण पूर्व तट में *एल.डसुमरी* और *एल. जोनेसी*।

सियनिडों के जाति संघटन और मुख्य जातियों की पकड में विविधता दिखायी पडी। इस वर्ग की अधिकतम पकड मुम्बई और वेरावल से प्राप्त हुई थी। काकिनाडा से ट्रालरों के ज़रिए 197 ट. सयनिडों के तरुणों का विदोहन हुआ था। सब से अधिक पकड जनवरी में मिली थी। लिज़ार्ड मछली में प्रचुर था *सारुदा तुम्बिल*। कोचीन को छोडकर पश्चिम तट में यह मिल गया था जबकि *एस. अनडॉस्क्वामिस* पूर्व तट और कोचीन में पकडा गया था। उत्तर पूर्व तट में अप्रैल और दिसंबर में श्रृंग पकड मिली थी। वेरावल में *पोलिनेमेस इंडिकस* का आकार माप जो विविध आयामों में मिला था, इस प्रकार है: ट्राल 170-770 मि मी, गिलनेट 310-1090 मि मी। मुम्बई में ट्राल में मिले *पी. हेप्टाडाक्टइलस* का आकार माप 65-275 मि मी था।

वर्ष की प्रथम व अंतिम तिमाहियों में मुम्बई और वेरावल से पाम्फ्रेटों की अच्छी पकड मिली थी। सतपति में अगस्त और अक्तूबर में गिलनेट में 250 कि.ग्रा. 725 कि.ग्रा. की उच्च पकड दर दिखाई पडी। मुम्बई में *पाम्पस अरगेन्टस* प्रचुर था।

बुल्स आइ और *प्रियाकान्थस हामरर* सभी केंद्रों में मिला था और इसका अवतरण परास 90-350 था।

चपटी मात्स्यिकी दक्षिण पश्चिम तट में प्रचुर थी। उत्तर केरल और दक्षिण कर्नाटक से *साइनोग्लोसस माक्रोस्टामस* प्रचुर मात्रा में मिला था। दक्षिण केरल और मान्नार की खाडी से *सी. बिलिनेटस* और *सी.माक्रोलेपिडोटस* भी।

मंडपम और विशाखपट्टनम के बीच के पूर्व तटों से प्रचुर मात्रा में गोटफिश प्राप्त हुआ था। तमिलनाडु में *एस .सुन्डेइकस* और *यू. सल्फ्यूरेइस* और आंध्रा के उत्तर तटों से *यू. विट्टाट्टस* प्राप्त हुए।

दक्षिण पश्चिम तट के वाइट फिश उत्पादन में वृद्धि दिखाई पडी। मिली पकड का आकार माप 30-209 मि मी था।

पकड में खाद्येतर नितलस्थ जीवजात भी था। कुल पकड में केरल में यह 7.8% और कर्नाटक में 3% था। कर्नाटक में मछली पकड का 47% 30 मी से कम गहराई से, 34% 40-50 मी गहराई से और 19% 50 मी से अधिक गहराई से प्राप्त हुए थे। केरल में कुल पकड का 40% 30 मी से कम गहराई से प्राप्त हुआ था और तमिलनाडु में 8% पकड ट्राल के ज़रिए 0-30 मी से प्राप्त हुई।

क्रस्टेशिया में सब से अधिक पकड पेनिआइड झींगों की थी। यह 42.8% थी। अन्य जातियों की पकड इस प्रकार है: पेनिआइड झींगा 36.4%, स्टोमाटोपोड 13.3%, कर्कट 6.9%, चिंगटी 0.6%। दक्षिण तट से पेनिआइड पकड का 75% और उत्तर पश्चिम तट से 93% प्राप्त हुए। पश्चिम तट में *पारापेनिअस स्टाइलिफेरा* और उत्तर पश्चिम तटों में *सोलेनोसारा क्रासिकोर्निस* की प्रचुरता थी। गहरा समुद्र मत्स्यन बढाने से *सोलेनोसेरा चोप्राइ* की पकड में वृद्धि दिखाई पडती है। दक्षिण पश्चिम तटों में *पी. सेमिसुल्काटस* और उत्तर तमिलनाडु और आंध्रा के तटों में *एम. डोबसोनी* प्रचुर थे।

वर्ष के दौरान मिले नॉन-पेनिआइड झींगों का 93% गुजरात और महाराष्ट्र से हैं। पकड में 24% बढती दिखाई पडी। मूलत: ट्रालरों के ज़रिए इसकी पकड हुई थी। चिंगटी पकड में घटती की प्रवणता दिखाई पडी। पकड केलिए यान और ट्राल जालों का उपयोग होता था। वेरावल में *पानुलिरस पोलिफागस* और *थेनस ओरियन्टालिस* और मुम्बई में *पी. पोलिफागस* मुख्य पकड थी।

कर्कट की पकड में दिखाई पडी घटती 12,000 ट. थी। पकड में मुम्बई व वेरावल में *कारिब्डिस क्रूसियाटा*, कारवार में *पी. पेलाजिकस*, मांगलूर में *पी. सनगुनोलेन्टस* प्रचुर थे।

शीर्षपादों की पकड में दक्षिण तट केंद्रों में घटती और उत्तर तट केंद्रों में बढती दिखाई पडी। पश्चिम तटों में स्क्विड व उत्तर तटों में कट्टिल फिश मुख्य पकड थी। केरल और तमिलनाडु तटों से 3700 ट. शंबु प्राप्त हुए। *पेरना इंडिकस* प्रचुर मात्रा में मिला था। कारवार, मांगलूर, कोचीन, मद्रास व काकिनाडा से 38,000 ट. सीपी प्राप्त हुए।

समुद्र कृषि

कोचीन में ग्रूपर (*एपिनोफेलस टाविना*) के अंडशावक विकास व प्रजनन में अभूतपूर्व सफलता प्राप्त की गई। इनके पोतों से अंडजनकों की आयु तक पालने की रीति, लिंग विपर्यय, परिपक्वन, स्फुटन और बीज संकलन पर किये गये परीक्षणों का शुभपर्यवसान हुआ। विषिंजम की जलजीवशाला में क्लाऊन मछली (*आम्फिप्रिओन क्राइसोगास्टेर*) का स्फुटन करवाया और उनके तरुणों तक का पालन सफल देखा गया। कारवार में पहली बार

प्रयोगशाला स्थितियों में *मेरगुनेनसिस* झींगा के अंडजनन और स्फुटन सफल देखा गया। कृत्रिम बीज संकलन में मोनोडॉन झींगों ने स्फुटन करके 39,93,000 नाप्लियों को जन्म दिया। जैव खाद्य संवर्धन पर किए परीक्षणों में *ब्राकियोनस रोटन्डिफोर्मिस* और *मोइना माइक्रूरा* के पालन में सफलता दिखाई पडी। *पेलाजिकस* कर्कट का एफ-4 पीढी का विकास मंडपम में किया गया। *एस. ट्रान्क्विबारिका* कर्कट के पालन में पेन रीति अनुयोज्य देखी गयी।

द्विकपाटी पालन में खाद्य शुक्ति का बीज उत्पादन और समुद्र रैंचन सफल देखा गया। टूटिकोरिन में कट्टल फिश (*सेपियेल्ला इनर्मिस*) के पालन में बडी सफलता पाई गई। प्रयोगशाला में पालित इनके डिंभकों ने परिपक्व होकर 75 वाँ दिन स्फुटन किए।

मुक्ता शुक्तियों से मोती उत्पादन करने की दृष्टि से विशाखपट्टनम में इनका परिपक्वन और प्रजनन पालनघरों में किए जाने का श्रम अग्रसर है।

पर्यावरण संबंधी अभिलक्षणों का मोनिटरन

मात्स्यिकी पर्यावरण से जुडी हुई कई सूचनाओं का संग्रहण पोतों और अभितटों से किया गया। प्रदूषण मोनिटरन कार्यक्रमों में पानी व अवसाद में टी एच ए लेवल संबंधी अध्ययन पर विशेष ध्यान दिया गया और अनुमान लगाया गया कि यह पादपप्लवकों की बढती उन्नत करती है जिस से प्रदूषण कम होता है।

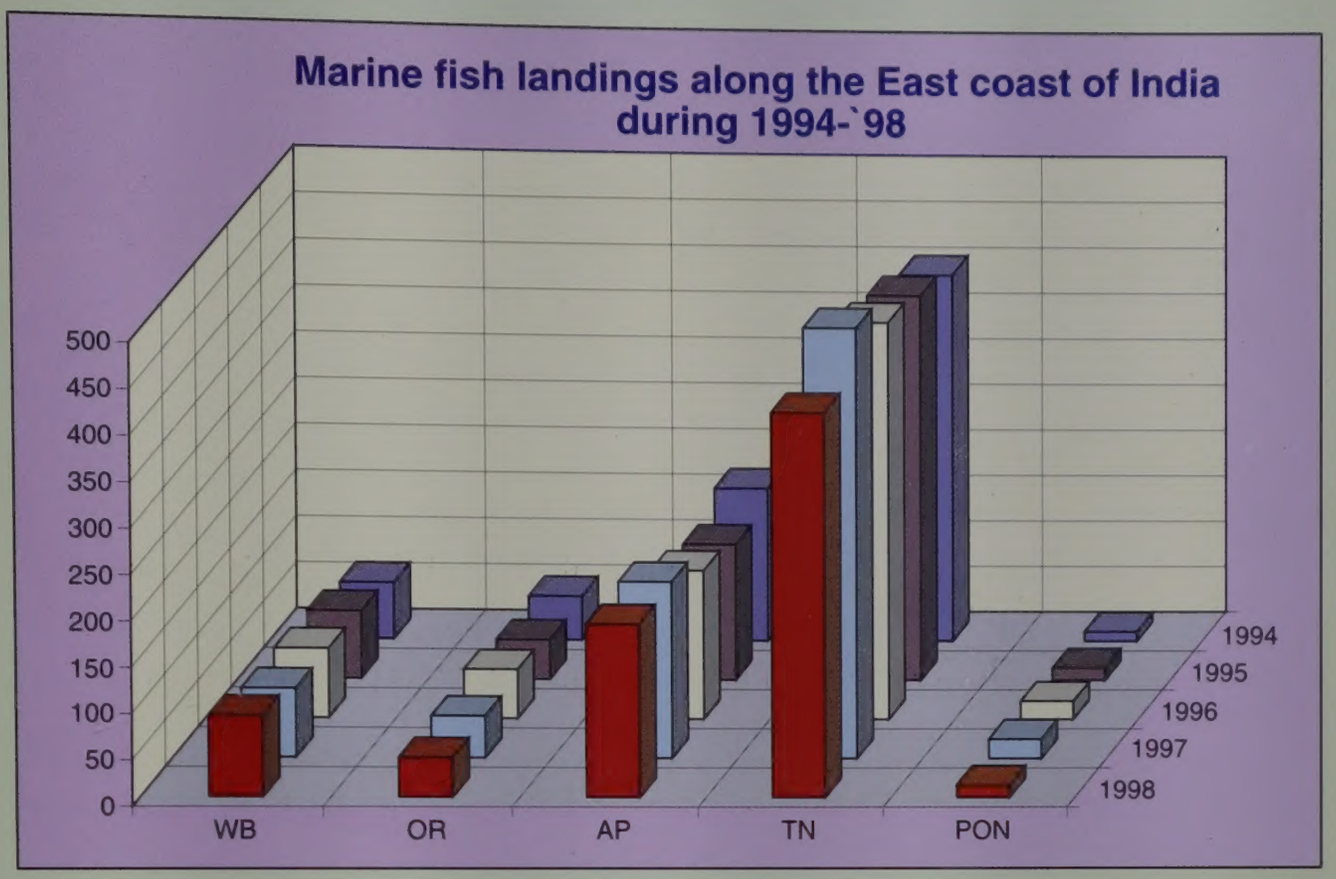
जैववैविद्यता पर विश्वविद्यालयों और केंद्रीय औषध अनुसंधान संस्थान के सहयोग से चलाये जाने वाले अध्ययन जारी रखे।

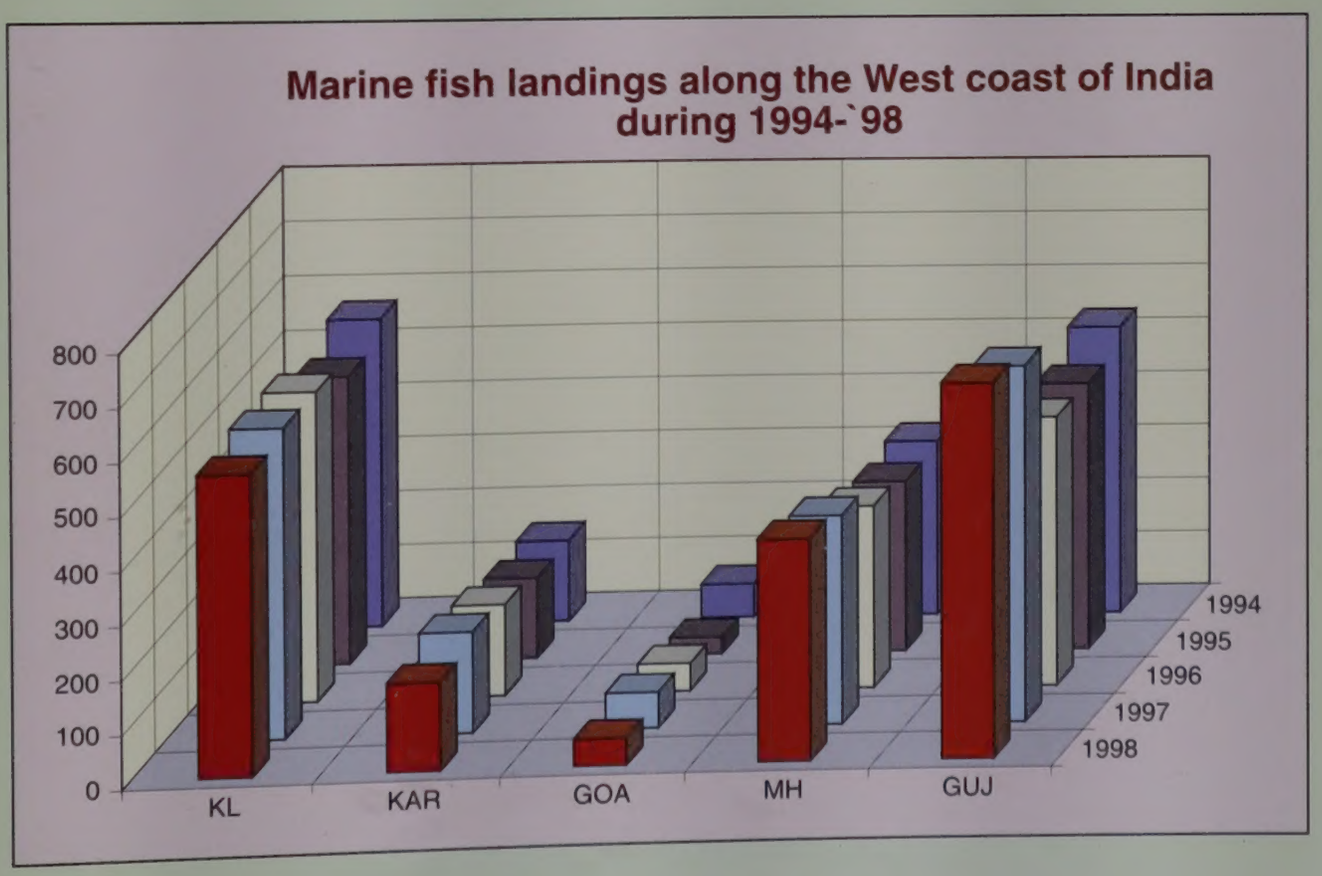
रोगविज्ञान, पोषण, प्रेरित प्रजनन, औषध गुण युक्त वस्तुओं के निचोडन आदि संबंधी अध्ययन जारी रखा। महिलाओं और छोटे सीमांत किसानों के प्रबलीकरण की दृष्टि से विस्तार कार्यक्रम प्रबल किए गए।

प्रायोजित परियोजनाओं की उपलब्धियाँ वांछा के अनुसार थीं। कुल मिलाकर 9 परामर्श परियोजनायें पूरी की गई और 5 चालू हैं। 4 अतिरिक्त परियोजनायें विचाराधीन हैं।

शिक्षा और प्रशिक्षण

संस्थान के 7 छात्रों ने मात्स्यिकी विज्ञान में स्नातकोत्तर उपाधि प्राप्त की और 3 छात्रों के पीएच डी का थीसिस अधिनिर्णयन केलिए रखे गए हैं। कृषि विज्ञान केंद्र के अधीन 33 और प्रशिक्षकों के प्रशिक्षन केंद्र के अधीन 10 प्रशिक्षण कार्यक्रम चलाए गए।


Marine fish landings along the East coast of India during 1994-`98
500
450
400
350
300
250
200
150
100
50
0
WB
OR
AP
TN
PON
1994
1995
1996
1997
1998


Marine fish landings along the West coast of India during 1994-`98
800
700
600
500
400
300
200
100
0
KL
KAR
GOA
MH
GUJ
1994
1995
1996
1997
1998